The science news monthly

SCIENCE DIGEST

JULY 1965 35 CENTS ICD

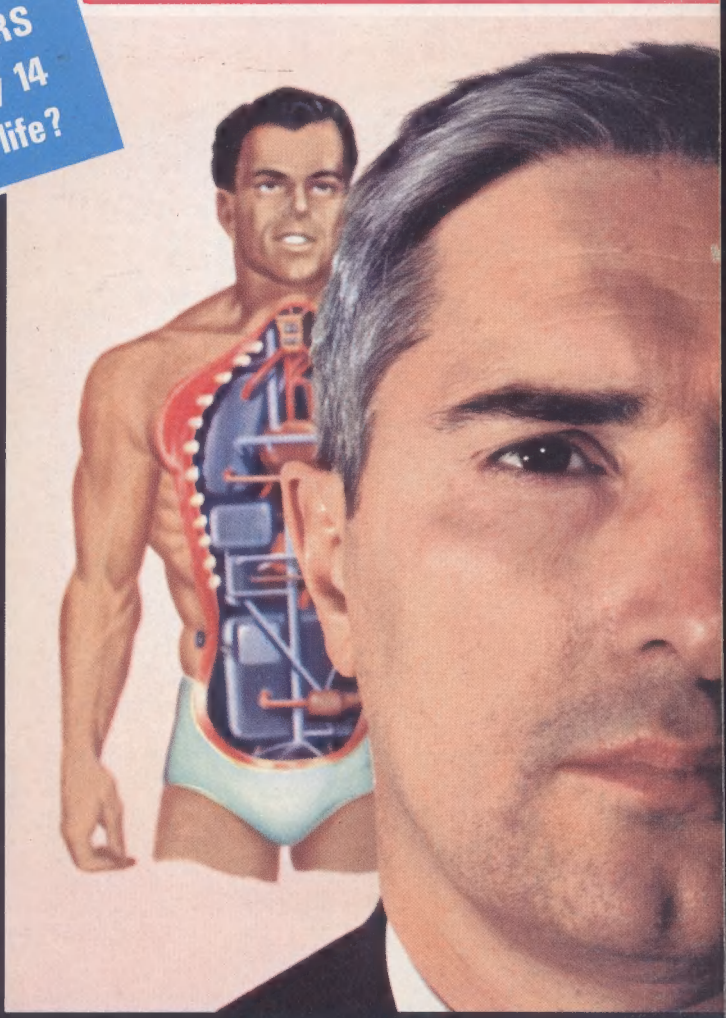
TV from MARS
Will the July 14
shots show life?

Death isn't necessary

The day we run out of water

Scientific secrets of fitness

How animals go crazy when they're overcrowded



THE MAN G. E. PAYS TO BE 'WAY OUT'

Falling on the moon

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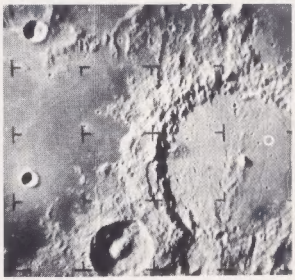

266 miles to impact

141 miles to impact

95.5 miles to impact

65.4 miles to impact

50.3 miles to impact

35 miles to impact

12.2 miles to impact

4.5 miles to impact

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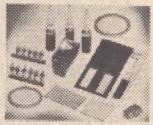

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June SCIENCE DIGEST Feature Article

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FOUR articles by the same man in one issue of *Science Digest* is something of a record. It is set this month by Bruce H. Frisch, an assistant editor whose year-round research into science developments happened to come to fruition in four areas at once.

Frisch's reports cover the extraordinary man on our cover who works for General Electric; a challenging new wrinkle in physics research; life on Mars, and how overpopulation affects animals.

THIS MONTH

In getting the facts for his articles, Frisch says, "I got my biggest reception at Brookhaven." That's where he researched this month's physics report. "Hardly ten seconds after I stepped in the door of the AGS building and gave my name to the receptionist, a secretary came scrambling down the stairs from the head man's office. She thought I was David Frisch, professor of physics at MIT. After I tried to understand the fifth force and CPT, I wished I were."

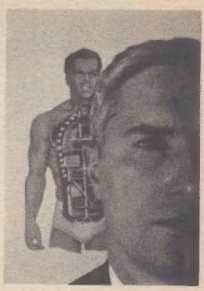
Even so, we're sure you'll agree, he managed handsomely to catch the gist of perhaps the most abstruse area of scientific research today.

"The overall lesson I learned from all four stories," Frisch pointedly adds, "is to be prepared for change like we have never known before."

THE EDITORS

SCIENCE DIGEST

Twenty-ninth year of publication



The closed-cyle man at left runs on a battery and his own wastes. He may be "feasible during the next 50 years," and immortality and resurrection are possible later, Dandridge Cole, at right, has alerted his employer, GE. See page 9 for more on Cole and his predictions.

Photo: Bruce H. Frisch

JULY • 1965 VOL. 58, NO. 1

SCIENCE THIS MONTH

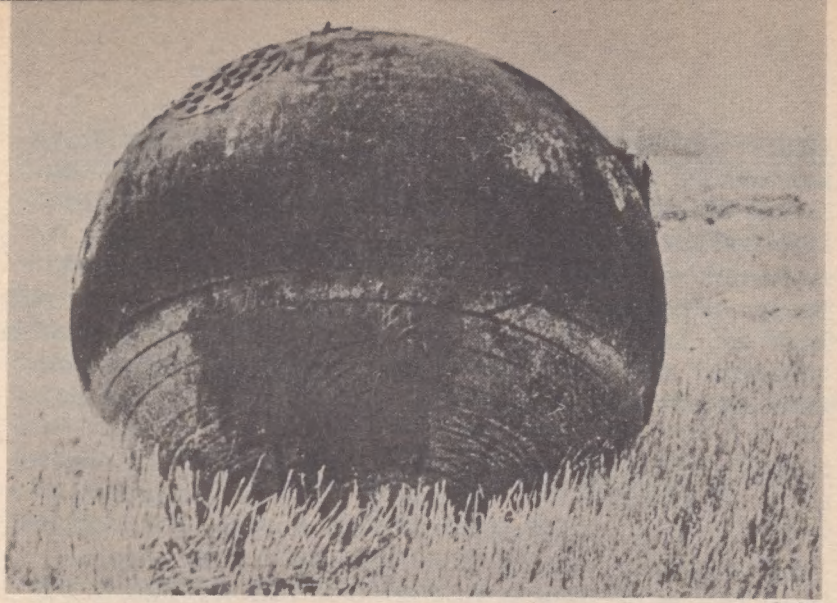
SCIENCE PANORAMA

SCIENCE MISCELLANY

THE LATE SCIENCE NEWS

EDGE OF THE UNIVERSE. Discovery of the most distant object ever identified has been announced by Astronomer Maarten Schmidt of the California Institute of Technology. It is a quasar (or quasi-stellar radio source) known as 3C-9. The object is so far away that the light from it may have begun its journey soon after the birth of the universe. From the few fuzzy lines 3C-9 inscribes on photographs taken by the 200-inch telescope on Mount Palomar, Dr. Schmidt has been able to estimate that the quasar is racing away from earth at 80 percent of the speed of light. Quasars like 3C-9 are changing our conception of the universe. Today their distance and the source of their enormous energy are a puzzle to astronomers, but the time is approaching when they may be the key to the origin of the universe.

SOFT LANDING FAILURE. The Russians failed in their first attempt to "soft land" a vehicle on the surface of the moon, probably because of some failure in the craft's braking rockets. American space engineers, who will attempt to "soft land" a Surveyor spacecraft this fall, sympathized with the Russian failure, and pointed out that this type of shot is extremely difficult. An East German observatory reported that it photographed a huge cloud of dust on the moon as the Soviet craft approached for a landing. This indicates the braking rockets did not fail completely, because the cloud was produced when the rockets fired.



Sovfoto

SPHERICAL SOVIET SPACECRAFT. The Soviet Union has finally released photographs of its manned spacecraft. The photo above is described as "the recoverable capsule of the Vostok" spacecraft, Russia's one-man satellite. The capsules that have carried more than one man into orbit are being called Voshkods. No additional information was given out with the Vostok photo but it shows features that U.S. space experts find puzzling. Unlike the Mercury, Gemini and Apollo capsules, which are conical in shape, the Soviet craft is spherical. The U.S. tested the spherical shape and found it unacceptable. Another intriguing aspect of the Vostok is the concentric rings which cover about one third of the craft's surface. Experts speculate that it is a heat shield, but a heat shield should be smooth as possible. Are the rings the remains of a shield burned during reentry? The Soviets aren't saying.

EIGHT AT ONCE. Early in the year, the U.S. secretly placed eight military satellites into orbit with one rocket. News of this record-breaking multiple launch was not announced until months after it was made. Many details of the launch are still secret but it is believed that the satellites were stacked one on the other atop the booster and separated in space by simple springs.

MONEY FOR THE MOON. The House of Representatives passed, virtually without change, the Johnson Administration's $5.18 billion request for funds for the National Aeronautics and Space Administration. Most of the money is earmarked either directly or indirectly for the Apollo manned moon shot.

MERCURY ROTATES. Contrary to previous belief the planet Mercury rotates slowly on its axis. This finding was made with the giant radio telescope at Arecibo, Puerto Rico (see Science Digest May '65). Mercury may spin west to east, like the earth and most of the other planets in the solar system, every 59 days. Earlier observations indicated that the planet kept the same face to the sun, just as the moon does to earth. Dr. Thomas Gold, Cornell University astrophysicist, speculated that this discovery might mean that Mercury has not been in its present orbit very long, and that it might once have been a moon of Venus that became "detached" and drifted into its own orbit around the sun 400 thousand years ago. Astronomers at Arecibo also discovered a smooth region on Mars (see page 44). The region seems to coincide with the dark areas that change with the season.

CHINA'S SECOND A-TEST. By a combination of espionage and careful analysis of fallout, Western scientific and political experts are trying to piece together more details about Peking's second atomic bomb test. If the bomb was dropped from a plane, as physicist Ralph Lapp has suggested, it would mean that the Chinese have refined their device into a deliverable weapon, something American officials thought was several years off. The Chinese have consistently claimed to have a deliverable bomb and a system capable of carrying it.

NEW VACCINE. Scientists at the National Institutes of Health have developed a new concept in immunization against respiratory viral infections. In tests, the vaccine has been 100 percent effective against adenovirus-4 which causes a severe flu-like ailment and sometimes leads to pneumonia. The new technique requires the vaccine to be taken by mouth, thus placing it in a part of the body where it will not produce disease but where it will stimulate antibodies that neutralize any virus that might later enter susceptible parts of the body. The vaccine will have no immediate effect on the treatment of the common cold which is caused by a great number of different viruses, but the technique may be useful against many other respiratory virus diseases.

LSD AIDS ALCOHOLICS. Limited tests have indicated that LSD and other mind drugs are more successful in keeping alcoholics sober than any other medicine, psychotherapy or group support activity, such as that of groups like Alcoholics Anonymous.

MILTOWN DROPPED. Meprobamate, known best by one of its trade names, Miltown (also marketed as Equanil), has been dropped from the new edition of the prestigious U.S. Pharmacopeia. Doctors have begun to seriously doubt the drug's effectiveness as a tranquilizer. There are also indications that Miltown can become addictive at dosage levels not much above recommended. The drug will still be sold but as a sedative rather than as a true tranquilizer.

SCHIZOPHRENIA CLUE. Two scientists from the Rockefeller Institute have detected a mysterious substance in the blood of schizophrenics. The discovery may be a clue to the suspected chemical basis of the mental disease, but chemist Dr. D.W. Woolley is cautious because at least five similar discoveries have come to nothing.

QUOTE OF THE MONTH: "I tried to persuade my colleagues in governments and in the United Nations that Nagasaki should be preserved exactly as it was then (1945). I wanted all future conferences on disarmament, and on other issues which weigh the fates of nations, to be held in that ashy, clinical sea of rubble. I still think as I did then, that only in this forbidding context could statesmen make realistic judgements of the problems which they handle on our behalf. Alas, my official colleagues thought nothing of my scheme; on the contrary, they pointed out to me that delegates would be uncomfortable in Nagasaki." J. BRONOWSKI of the Salk Institute for Biological Research in a new edition of his book "Science and Human Values."

PERSONALITY OF THE MONTH

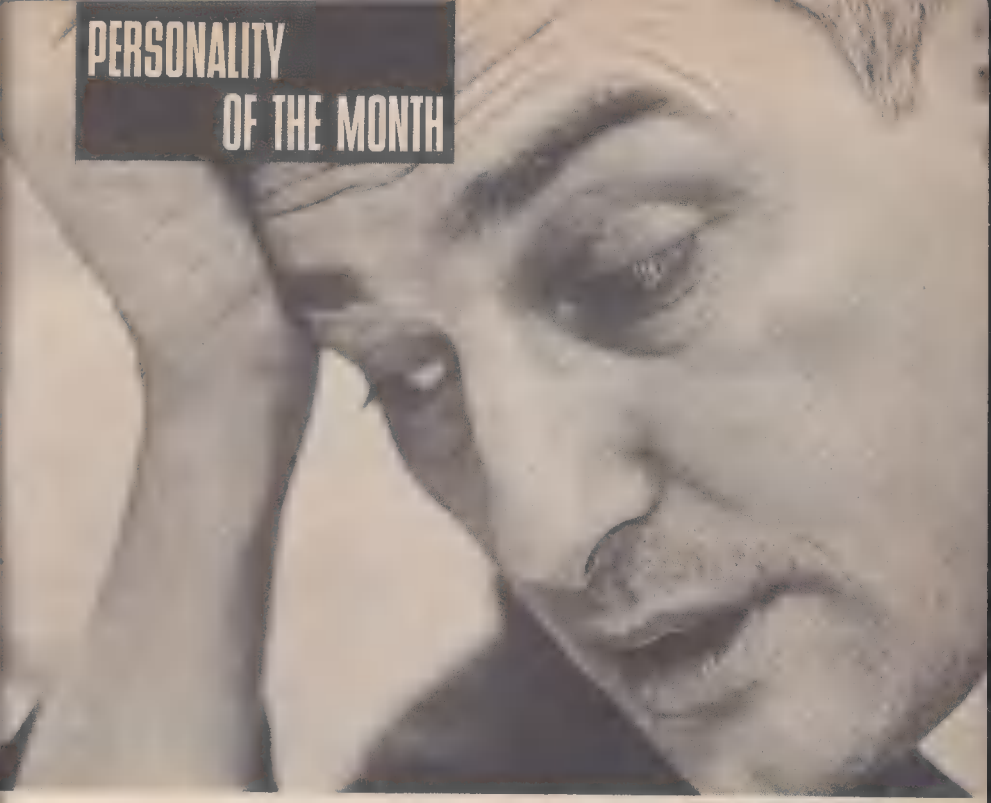


Photo by Bruce H. Frisch

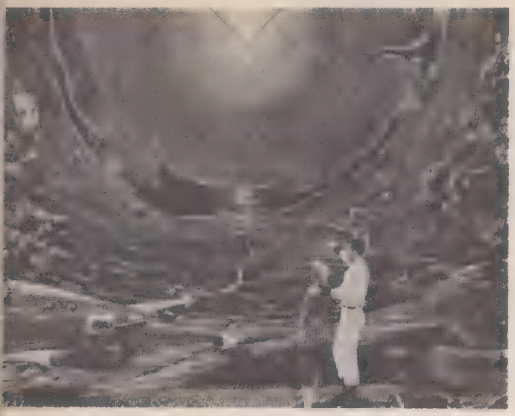
Dandridge Cole: G.E.'s way-out man

by Bruce H. Frisch

LOOKING like the boys'-school science teacher he once was, Dandridge Cole sat in the company cafeteria, eating a lunch of roast beef, stewed tomatoes and pecan pie. He wore a dull gray suit, steel-rimmed glasses and an upright expression.

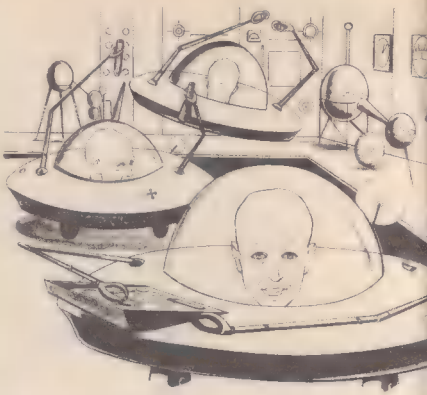
Then he started talking about the future—10, 50 and more years from now. His ordinariness dropped away as he spoke.

"I'm pushing manned interplanetary flight in the '70's," he said, around a mouthful of pecan pie. "Right now, the thinking is we won't do it until 1985, when we have a nuclear rocket. With Saturn



The spin of a hollow asteroid would press the inhabitants against the shell. Rain would fall outward, and then flow to the widest part, creating an equatorial ocean.

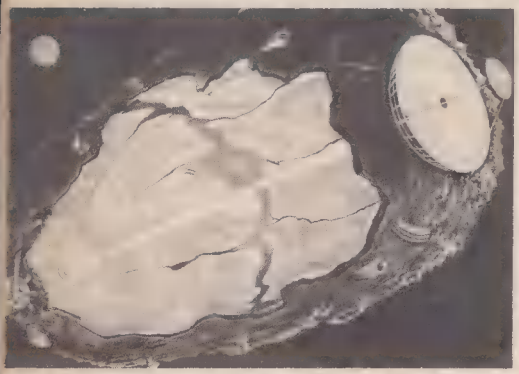
A mirror outside the hollow asteroid would collect sunlight and direct it through an axial, gas-filled tube. Thus the "sun" would be shaped like a fluorescent lamp.



Roy Scarfo

Saucer men may be the final result of replacing worn out body parts with mechanical substitutes. Only the head with its intricate brain would remain truly human.

A 15-mile-long electric launching tube on a planetoid would be an energy-saving stepping-stone to the planets. A thick atmosphere prevents use of one on earth.



5's, we can go to the moons of Mars, and the planetoids and make fly-bys of Mars or Venus—in the 70's, without a nuclear engine." He went on from there.

It sounded fantastic. Yet the world of the future Cole describes is the result of hard-headed analysis. He is paid to conjure up the future by one of the giants of U. S. business, the General Electric Corporation. He is Consulting Astronautical Engineer for GE's Missile and Space Division in Valley Forge, Pa.

By his own count, he is one of five men in government and industry seriously exploring the future. They are men paid to be "way out"

because science and technology are moving so fast that, unless major developments are foreseen, events almost always take the most adventurous orthodox planners by surprise.

Cole's No. 1 area of exploration is space. To him, it is no abstract concept, but a place that could be home for many of us living today.

Flight to the planetoids will be a key to exploration and colonization of space, he believes. The planetoids, or asteroids, or minor planets, orbit the sun in a wide belt between Mars and Jupiter where astronomers had expected to find a planet. The largest planetoid, Ceres, is 480 miles long. Some have eccentric orbits which curve within hundreds of thousands of miles of Earth. These are the easiest and cheapest extraterrestial bodies to visit.

In the 1980's, we might capture one by firing thousands of megatons' worth of nuclear bombs at the right point in its orbit to steer it toward a new orbit around Earth.

Metallic planetoids could be mined for building rocket casings and similar equipment on the spot. Precious metals could be shipped back to Earth.

Stone and ice planetoids would provide raw materials for making liquid oxygen and hydrogen rocket propellants to stock a space filling-station.

Of course, there is nothing to prevent someone from setting off a nuclear bomb as a retro-rocket and crashing a captured planetoid into Earth, as Cole pointed out a few years ago. When the wire services sent the "asteroid bomb" story out to the nation's newspapers, Cole got a sheaf of mad-scientist letters accusing him of wanting to destroy the world. Instead, he said, "It was a warning we should go into space."

Cole was also the author of the Panama Theory, which says that there are strategic areas in space as important to getting to outer space as the Panama Canal was to reaching the Pacific. These strategic areas could be denied to us if first occupied by an unfriendly power, Cole argues. The moon is one example; some of the planetoids could be others.

Stepping stone in space

One way a planetoid could act as a stepping stone to outer space is as the site of an electric catapult or cannon. This catapult would be a linear electric motor in the shape of a tube stretching perhaps the 15-mile length of planetoid Eros. Firing a spaceship from the catapult would reduce the size and cost of the rocket booster. A space ship scooped up by the tube on an inbound flight would generate power as it was braked to a stop.

At each launching, the planetoid would recoil slightly as a gun does when it fires a bullet. Bit by bit, the planetoid would be knocked out of position in its orbit. To correct this, wire could be wrapped around the planetoid. Current passed through the wire would turn the iron planetoid into an electromagnet which

In the next 50 years, Cole foresees, 10,000 colonizers at a time may venture into space in vehicles the size of ocean-going liners.

would interact with the Earth's magnetic field to guide the planetoid back into place.

Bases like these, although simpler at first, will inevitably follow manned landings on the moon, Cole thinks. Too few people will be able to emigrate to space to solve the world's population problem, he cautions, but colonization will ensure the survival of the human species if the population explosion ends in catastrophe for Earth.

Cole likens the ability of the species to colonize to the ability of an adolescent to reproduce when he reaches maturity. Another parallel is the control of our destiny we will gain from a predicted 256-fold increase in knowledge over the next 50 years. The human species will reach maturity in the next 50 to 100 years, says Cole. This theory is his one idea he feels is influenced by his Swedenborgian religion.

Planetoid colonists may carve out caves or build domes in which an atmosphere would be sealed. Recently, Cole studied proposals to terraform the moon, that is, give it an atmosphere and fashion it into a miniature Earth. He concluded that the smaller-scale microcosms would be better.

All wastes would be reused in these colonies so that the only thing entering or leaving the closed system would be energy, either solar or nuclear. Closed-cycle society would be the next step in the organization of matter, which until now has gone through the progression from energy to sub-atomic particles, to atoms, to molecules, to unicellular life, to multicellular life. Cole calls it Macro-life.

Macro-life

"The most highly advanced form of Macro-life which may develop in the next 50 years is the colonies of perhaps 10,000 people in Queen-Mary-sized space ships, or the asteroid colonies. These highly developed societies can cruise indefinitely in the solar system or even venture out into interstellar space," he writes.

The completely artificial surroundings of a space ship may prove depressing, so Cole suggests an alternative. He would focus sunlight from a parabolic mirror onto an iron planetoid. The temperature would rise until the planetoid was as plastic as molten glass. Then he would blow it up into a giant bubble and let it harden. The inside surface could be covered with soil, trees could be planted, an atmosphere formed and everything else necessary done to make it Earth-like. Sunlight could be beamed in one end and the whole planetoid given a spin to provide gravity.

Living like this, the inhabitants could set course on an exploratory voyage of space that could last generations or even forever.

Fantastic? Perhaps it seems so because we are so unused to thinking about the future.

"I definitely do not think there is enough thinking about the future in the country as a whole, not in the government, not in the universities. We spend a lot of time studying past history, but not enough on future history. When we design a weapons system, we think of the environment it will exist in. It's the same with a student. He should be prepared for the future," said Cole.

Cole started looking ahead early. "When I was in the sixth grade, I thought I had invented a ray gun. I related this to my father, who was a PhD in chemistry. He was rather scornful.

"I demonstrated a rocket to my teacher and class in the eighth grade (1935). I was reading science fiction and Buck Rogers and articles in the paper about Goddard."

In college, he aimed at being an explorer equipped with all the talents of a one-man team who could make a complete study of an area alone. He passed from the pre-medical course at Princeton to medical school in 1942, but quit after a year to join the paratroopers.

"I didn't really do too much except what I was told—part of the time. I thought up the frogman idea independently. It was highly secret at the time. I finally got through to the OSS. They didn't want to talk about it, because they didn't know how I had found out about it. It made them nervous," Cole recalls.

After the war, Cole went back to school to learn physics. He received a master's degree from Penn in 1949 and got a job teaching science at Phillips Exeter Academy, a boys' prep school in New Hampshire.

"I taught what I think was the first course in astronautics in any secondary school and perhaps in any school. It was called astrono-

Cole combs publications and calls friends for ideas. They send him postcard tips.
Photo by Bruce H. Frisch

In the future, if someone dies accidentally, he could be reproduced in exact replica, complete with quirks, by a blueprint of his genes.

my, but I used Willy Ley's *Conquest of Space* as a text," he chuckled.

"While I was at Exeter, things began to happen in space flight. Martin had the Viking program."

So he signed on with Martin in 1953. At first, he had to settle for the airplane end of the business. When he finally got into the new Titan program, he started calculating minimum-time orbits to Mars and Venus.

"These jobs weren't assigned. The boss knew what I was doing and rather than get into a fight, let me do it as long as I got my other work done. This gradually evolved until I had been doing these things without asking anybody and had been getting some recognition. I could then dicker with a new boss over how much time I'd spend on what I wanted. By the time I left Martin, it was half time, and I wasn't satisfied, and it was one of the reasons I left. When I came to GE, I could do pretty much what I wanted to do, but each side pretty much understood what I wanted to do."

Today, Cole spends most of his time reading through stacks of magazines and books covering the tables and window sills of his office, keeping up with science, especially space science, and absorbing other people's ideas. All the ideas he incorporates into his picture of the future are not his.

To the information he soaks up, he applies four forecasting techniques outlined in his GE monograph, *The Next Fifty Years in Space*.

Number one is the scheduling of present technical developments out to about ten years. Up to five years, the forecast is likely to be pessimistic because of unforeseen problems. Over five years, the forecast is likely to be optimistic, because of unforeseen breakthroughs.

A second technique is to project long-standing trends, watching carefully for factors that will bend the growth curve. In this way, "we can more often than not be correct in saying that *at least* a stated level of progress will be made," writes Cole.

Thirdly, he tests only the scientific feasibility of an idea and ignores the engineering problems. The engineers may come up against an insurmountable problem, but a completely new approach will often bypass it, Cole argues.

Lastly, he looks for significant new discoveries that have remained obscure, because they have not yet found a practical application. For a few years, nuclear fission fell into this category.

With this approach, he was able to answer a 1953 poll that a man

would arrive on the moon by 1970.

"It is surprising the kind of reasoning scientists will sometimes use," says Cole. "They'll calculate that to get to the moon will take a vehicle as big as the Statue of Liberty. Therefore, they'll say, that's conclusive proof you can't do it. Yet, that's exactly what we are going to do."

However, he said, "I would have to bet on the Russian's getting to the moon first."

Fate of the individual

He doesn't like other things he sees coming, such as the fate of the individual.

Organ by organ, Cole thinks, we will learn to replace our insides with mechanical substitutes. Eventually the individual will reach the same point as the closed-cycle society. All wastes will be reprocessed internally. Only water to replace perspiration and energy in the form of an atomic battery or rechargeable or replaceable batteries will enter the body from the outside. Another source of spare parts could be transplants from organ banks. Each person may have a set of organs on deposit grown from bits of his own tissue. This would get around the immunity problem.

Between now and then, when a person gets an incurable disease we may want to freeze him until we have a cure or can replace the diseased organ.

We will be immortal. No one will die, except accidentally. For those few it "would be an unfair universe," says Cole. But a man's family may miss him and have him resurrected. "We are talking about the limits of human capabilities," he adds. By studying his wife's and children's genes we could learn the genes a man had had and with that blueprint grow a new physical man. His personality could be reconstructed from the memories of the living, "which may be much more detailed than we are usually aware of." The reconstituted man would be checked against recollections of him. If they didn't match, we would change him.

"Whether it is really him or not is another question," Cole says. However, we would know the times he had lived in, so "you crank in all the memories he should have so *he* thinks he's him, too."

Immortality is hardly the word. We won't be allowed to die.

Polar bears threatened by airplanes

THE great white bears that roam the frozen top of the world are vanishing. Polar bears have become easy targets for hunters giving chase in airplanes and armed with high-powered, automatic rifles. Since Polar-bear rugs are now in vogue, the magnificent white pelts bring high prices. With an estimated 10,000 polar bears still in existence, the threat of extinction is not immediate, but their numbers have been declining for several decades, according to the National Geographic Society. The Department of the Interior calls them an endangered species.

THE SPACE PICTURE

Preview of the big one

Right: NASA conducts a static test of all five engines of the Saturn V booster, which will provide power for the Apollo moon shot. The test ran for 6½ seconds, during which time the engines developed 7.5 million pounds thrust. Below: Boeing's mobile lunar laboratory model shows major components as they might appear when the vehicle is on the Moon. The cabin of the craft is insulated and pressurized.

Above: Rattlesnakes are among the original inhabitants of once desolate Merritt Island, Florida, which is now becoming an important part of the Kennedy Space Center. The snakes can crawl around freely. Workers are not allowed to molest them unless they actually disrupt work. This seven-footer was very disruptive. Below: The operational freedom simulator located at NASA's Houston Manned Spacecraft Center creates a zero gravity condition.

INVENTIONS PATENTS PROCESSES

Vegetable garden in space

A VEGETABLE garden in space is the goal of research currently under way for the U.S. Air Force at the Columbus Laboratories of Batelle Memorial Institute. Broad-leafed plants, such as sweet potatoes, beets and turnips, are being evaluated as a source of oxygen and food for astronauts in the closed environment of space stations. The plants are grown in a soil-less culture.

Of the approximately 100 edible plant varieties considered to date, the most promising appears to be the common sweet potato. Its tuberous root yields a large number of calories per pound and contains a comparatively high amount of Vitamin A. Also, the sweet potato leaves are edible either raw or cooked.

The sweet potato ranks high in other respects, for example, in relation to food calories produced per unit of time per unit of growing area. Another advantage is that it can be propagated by vegetative means. A stem cutting takes root in a few days and will produce edible roots in 90 to 120 days.

In the initial portion of the two-year program, short-term studies are being conducted to determine optimal growing conditions, such as day length, temperature, and carbon dioxide concentration. Studies of gas exchange are made in a photosynthesis chamber.

The apparatus can provide a range of light intensities up to full sunlight in the visible range of the spectrum. Lighting is provided by 24 fluorescent tubes lining the chamber, with an incandescent bulb at the top to furnish light in the red end of the spectrum.

In the final stage of the study, experiments will be carried out in growth chambers to learn the number of plants and the amount of growing space required to support one man. The value of human wastes as plant fertilizer also will be studied. The effects of a variety of gravitational conditions on plant growth will be investigated, including acceleration forces similar to those encountered during space vehicle launch, simulated lunar gravity, and weightlessness.

The first IBM 2361 Core Storage, right, has 16 times the capacity of any previous IBM memory. It will handle information needed by flight controllers to help astronauts guide Gemini and Apollo spacecraft.

Conversation piece held by its inventor, Alec H. Reeves, has solved the problem of congested telephone circuits. The system is known as "pulse code modulation."

1940 invention now important

An invention that has just now assumed the highest practical importance in the field of communications after lying dormant for 25 years was discussed recently by its inventor, Alec H. Reeves, a scientist from the International Telephone and Telegraph Corporation British subsidiary.

The invention, known technically as "pulse code modulation," is a means of transmitting and switching large numbers of telephone conversations economically by taking small sample "pieces" from each conversation and mixing and "coding" them as "pulses" like telegraphic signals. The many conversations are separated and reconstructed at the receiving end.

Mr. Reeves, of ITT's Standard Telecommunication Laboratories, London, notes that his concept, which has begun to be used in the U.S. and Great Britain, " ... is a good example of an invention that came too early ... Only in the last few years, in this semiconductor age, has its commercial value been felt."

Estimating the future impact of his invention on communication. Reeves forsees that by the year 2000, we may well be a nation of "stay-at-homes," because of greatly larger populations and a transportation problem that will require executives to handle business by telephone, since it will be impracticable for them to commute.

Reeves believes that by 2000 A.D. the major portion of our communications will be by pictures—television—transmitted in a still-to-be-developed system of light beams sent through pipes, the light carrying the messages in the form of his pulse code modulation.

192,000 characters per minute

A new ultra-high-speed digital printer, which records 192,000 characters per minute on photosensitive paper, has been introduced by the Monroe Data/Log Division of Litton Industries.

The MC 4000 printer will have wide uses where very rapid printout of computer data is required.

It can be used in missile or satellite tracking for a split-second-by-split-second progress record of the flight path. The Monroe MC 400 also can be tied into the control system of petroleum processing or steel plants to provide continuous or instantaneous recording of processes throughout the facility.

The new unit overcomes prob-

lems of punched tape recording, which is too slow, and magnetic tape, which is fast but not visible. The new unit prints 360,000 lines of recorded data per hour.

A spokesman for Monroe Data/Log explained that the MC 4000 accepts coded input, and converts it to digits or alphabetical characters. These are registered on the head of a cathode ray tube. A fiber optics bundle intensifies this image on the photo-sensitive paper, greatly speeding the printing and creating a clearer copy. It records 100 lines of data per second, without heat, drying, or photo chemicals.

Further information is available from Monroe Data/Log division, 343 Sansome Street, San Francisco, California.

Lunar oxygen experiment

The day is coming when astronauts will live on the Moon and commute between the Moon and Earth. When that day arrives, it will be possible to use the Moon's rock-strewn surface to manufacture oxygen for the astronaut's breathing equipment and to fuel their giant rocket ships.

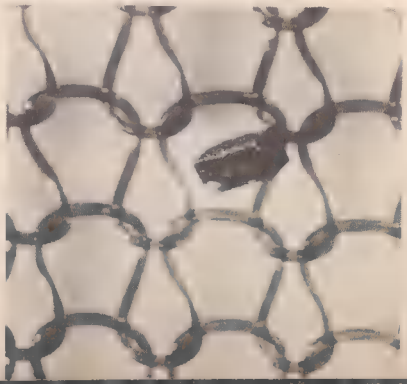
Science fiction? Not according to a team of Aerojet-General Corporation scientists at Von Karman Center, Azusa, California, who have completed a two-year research program for the National Aeronautics and Space Administration (NASA).

Recently, the Aerojet team announced they have successfully produced oxygen from three types of rocks which scientists believe are widely distributed on the Moon's surface.

Three kinds of rocks were melted in a specially designed furnace and subjected to a pair of chemical reactions to produce water. According to one member of the team, "When you have the water, it's no problem at all to electrolyze it and obtain oxygen and hydrogen." Then, by liquifying the oxygen, you produce propellant fuel to power rocket ships.

Large scale plants duplicating the above process could be built on the Moon's surface. This means astronauts commuting between Earth and Moon or going to other planets would not have to carry liquid oxygen with them to launch their spacecraft off the Moon. It also means that lunar explorers would be able to get oxygen refills for their life support equipment.

With its edge length of about a tenth of a millimeter, as shown here, the laser diode is so tiny it is dwarfed by the fine-gage meshes of a lady's stocking. Extremely fruitful investigations are now being conducted in connection with the use of lasers in communications engineering.



Liquid fuel into electricity

A fuel cell assembly that can convert liquid fuel into electricity has been developed by Esso Research and Engineering Company. The energy package, in a recent demonstration for the Army, produced almost 100 watts of electricity directly from methanol, a petroleum-derived liquid.

A fuel cell converts the chemical energy of fuels directly into electricity and, in theory, is the most efficient machine ever conceived. In practice, however, serious problems had to be overcome in developing a device that operates at relatively low temperatures, powered by potentially widely available fuels.

The new fuel cell battery is a significant improvement over earlier versions based on hydrogen and oxygen since it avoids the need for bulky gas storage units or high temperature operation. The new units respond immediately to generate useful power as soon as it is put in operation.

The fuel cell converts chemical energy of the fuel directly into electricity without combustion. Conventional batteries produce electricity from a built-in supply of chemicals which becomes exhausted. The fuel cells takes in a constant supply of fresh fuel and is able to generate electricity continuously and indefinitely. The more cells used, the more power produced. The Esso Research fuel uses air and methanol as fuel in an acid electrolyte.

Crab-cleaning machine

The Department of the Interior's Bureau of Commercial Fisheries announces the development of a machine to deback and clean blue crabs, an important part of the shellfish industry along the East and Gulf coasts.

Blue crabs are presently debacked and cleaned entirely by hand. Because of the rising labor costs and the loss of skilled labor to other industries, the shellfish industry has experienced diminishing returns in recent years.

The machine punches through the shell of the precooked crabs taking an amount of lump and flake meat comparable to that obtained by hand. The crabmeat is then easily removed from the shell and cartilage by hand. Preliminary tests indicate that the machine eliminates several steps of the hand operation.

Fluoridated mouthguards

Hamsters are rodents that ordinarily develop tooth decay like humans. But when they wore tiny plastic mouthguards coated with fluoride paste for a few minutes a day, the rate of decay dropped significantly.

A test has been started by the University of Buffalo among 400 children, ages 10 to 14, at a school near Buffalo, N.Y. They will wear medicated mouthguards, similar to those worn by boxers, for six minutes a day, five days a week, throughout the school year.

INVENTOR OF THE MONTH

A tough new family

A WHOLE new family of plastics is an important addition to any corporate community, so it's no wonder Du Pont sent out a figurative welcome wagon for the polyimides.

The family is not to be confused with its relatives, the poly*a*mides, which include nylon. The newcomers are tough, in a nice way, and according to Du Pont are the most heat-resistant organic plastics yet developed.

Two basic patents on the aromatic polyimides (Nos. 3,179,614 and 3,179,634) were recently obtained for the company by the *Science Digest* Inventor of the Month, Dr. Walter M. Edwards (above). The term "basic patent" is never defined, but indicates presumptive control, subject to whatever the courts may do. Du Pont's limited monopoly over the polyimides runs for 17 years.

The polyimide group includes solid molded forms, fabrics, thin films and liquids. Referred to as engineering plastics, they resist abrasion, radiation and many chemicals. Some, such as Pyre-M.L. insulating varnishes and enamels, are already trademarked and pretty well known.

Du Pont is preparing plants for production of the moldable form, Vespel, and the films.

Proposed uses of the film are as flexible printed circuits and as wrap for wire and cable. Because the insulating varnishes and films tolerate such high running temperatures, the company estimates that their use in an electric motor will permit increasing horsepower as much as 100 percent without increasing the size of the frame. At present production volume, the polyimides do not compete in cost with other plastics except in jobs suited to their special talents.

As they combine high strength with low weight, the polyimides are regarded as prime materials for supersonic aircraft and missile building. An experimental structural piece consists of two molded layers, with a honeycomb-shaped support material sandwiched between, all held together with polyimide adhesive.

Du Pont received four other polyimide patents, granted to Andrew L. Endrey and William R. Hendrix, on the same date as those awarded Dr. Edwards.

—*Stacy V. Jones*

BOOK IN THE NEWS

Scott poses with five breeds of dog he and co-author Fuller studied.

What dogs tell us about ourselves

Dogs have lived in close association with human beings for eight to ten thousand years. Even before domestication they had much in common with man; both were social animals and hunters. Dogs have shared most of the changes that have affected their masters. But since dogs have shorter lives and go through new generations much faster than man, they have had some 4,000 generations since they were domesticated while man has had only 400. Is it possible that the dog can give us some idea of the genetic future of mankind?

This question is posed by John Paul Scott and John L. Fuller in their book *Genetics and the Social Behavior of the Dog* (The University of Chicago Press, $12.50). Scott and Fuller have gathered information on dogs based on nearly 20 years of research at the Jackson Laboratory, where they are senior staff scientists. The result is an informative and unusually well written book. Many volumes of this type seem to scorn normal communication and almost defy the reader to finish them. Scott and Fuller, on the other hand, have put together a book that can be read with interest and profit by the layman, as well as by the geneticist and professional dog breeder for

Current dog breeding practices are an ideal system for spreading and preserving bad genes, yet there are more dogs today than ever before.

whom it is primarily intended.

The most fascinating part of *Genetics and the Social Behavior of the Dog* is the chapter which discusses the dog as a genetic pilot experiment for the human race. The authors' conclusions will give no ammunition to those who are either extremely optimistic or pessimistic about the genetic future of man.

The optimists are those who think that a super-man can be produced by selective human breeding. But the history of the dog does not support this view. Like modern man, all dogs have a common ancestor—the wolf, yet thousands of generations of very selective breeding have not produced a super-wolf.

The authors state, "Although many breeds of dogs consistently exceed wolves in their capacities, none of them can be considered super-wolves. Their special capacities have been achieved at the price of sacrificing others. The greyhound has achieved speed by sacrificing the heavy muscles and jaws which enable a wolf to live on bones if need be. . . . A wolf is a rugged and powerful animal adapted to life under a variety of adverse conditions. Consequently, no one of his behavioral capacities can be developed to a high degree. Compared with wolves, dogs are a group of specialists. But as they are coordinated and sheltered by human society, they can perform their functions more efficiently than any group of wolves."

If the evidence afforded by dogs is valid, the authors conclude, "the super-man is not to be found as an individual, but as a well-developed human society."

Natural selection relaxed

Pessimists, on the other hand, bemoan the genetic degeneration of the human race because of relaxation of the laws of natural selection. Human society protects its genetically weak and inferior individuals (like those with hereditary diseases) and makes no attempt to insure increased reproduction of the genetically superior.

The situation for dogs is even more extreme. "Not only has selection been relaxed because dog owners protect and feed their pets from the kennel to the grave, but fanciers have practiced breeding systems which actually increase and multiply injurious mutations. . . . Thus current dog breeding practices can be described as an ideal system for the spread and preservation of injurious recessive genes."

The authors note that there is no indication that the dog is becoming extinct because of genetic deterioration. "If anything, there are more dogs today than ever before."

Why isn't the weakened domestic dog dying off? Scott and Fuller state a number of convincing reasons. One is, "although 50 percent of the females are unable to produce living young, reproduction by a fertile animal is approximately double that of the ancestral wolves, as a good bitch may easily produce 50 living offspring by the time she is 6 years old. This increased reproductive capacity more than compensates for the genetic loss of fertility.

"We can conclude that the relaxation of natural selection in the dog has not produced a continuing process of degeneration but rather has set up a new condition of genetic balance which permits a wider degree of variation."

The conclusions for man: "Under present circumstances . . . genetically superior individuals are unlikely to produce a new race of men. If they appear they will make a social rather than a genetic contribution to the future. Even in this respect, their social value is likely to be relatively small compared to that of individuals with markedly superior special talents."

The authors continue, "Present conditions permit the survival of socially valuable but genetically specialized individuals, lacking the all-round survival capacities of Stone Age man, but possessing extremely superior special qualities which can be used to good advantage in a highly developed society."

—DC

How to engineer a heart

A MAJOR effort to develop a practical, foolproof artificial heart is being launched under the direction of the National Institutes of Health. It may cost upwards of $100 million, but is expected to yield results within five years.

The National Institutes of Health will adopt the space program's method of awarding contracts first for systems analysis, and then for actual development and building of an artificial heart. The systems analysis stage will result in a master plan, giving details of what is needed, how the heart will work, how long it will take to make it and how much it will cost. Development contracts will then be let to build and test a model.

Efforts to develop such a device have already been started at various research institutions throughout the country. Apparently, the major hurdle is not the artificial heart itself, but the power to pump it. The pumps being tested have power sources utilizing air pressure, electrical power, hydraulic pressure or nuclear energy.

The typical air pressure pump, for example, mechanically compresses flexible plastic chambers inside a rigid housing that serves as the "heart." Other types include one with durable plastic pumping chambers which can be powered by a jeep engine; an electrically-powered compressor pump, which uses hydraulic fluid to compress the heart chambers; a steam engine pump powered by radio-isotopes; and a small air pressure pump attached to the waist, with a thin tube carrying air into the chest and heart.

THE ASTRONOMY STORY

Ring around the stars

Mt. Wilson and Palomar photograph

Spiral galaxy M-81 as photographed at Mt. Palomar. A single photo is not able to pick up the faint ring of luminous gas that circles this distant island universe.

MILLIONS of light years out in space, an enormous explosion in a galaxy may have thrown a huge ring of faintly luminous gas around another nearby galaxy.

This spectacular cosmic cataclysm may give astronomers the chance to measure the strength of the overall magnetic field of a galaxy for the first time.

The ring is located around the galaxy, or island universe of stars, known only by its catalogue number, M-81. It is about 10 million light years from earth (60 billion billion miles). Finding of the ring was reported by Dr. Halton C. Arp of Mt. Wilson and Palomar Observatories, operated by the California Institute of Technology.

Dr. Arp thinks the ring may be caused by high energy electrons trapped by the galaxy's magnetic field. Near M-81 (at least in celestial terms) is a similar galaxy known as M-82 in which there was a cataclysmic explosion. Why or how this explosion took place is unknown, but Dr. Arp believes that the electrons thrown off by it shot

over to M-81 at a speed near that of light. At that rate it would have taken them 10,000 years.

The explosion in M-82 must have taken place some 10 million years ago, because the light would have had to travel that long to reach earth.

M-81 and M-82 are not visible from earth with the naked eye but their images are easily photographed through the 48-inch Schmidt telescope on Mt. Palomar. They lie in the direction of the constellation Ursa Major, the Great Bear, also known as the Big Dipper.

The ring is much fainter than the galaxy, and Dr. Arp had to make long exposures and then superimpose three negatives to locate it. The brightness of the ring is only about one half of one percent greater than that of the night sky. The pictures were taken last year at a time when the sky was as dark as possible.

M-81 is a spiral-shaped galaxy similar to our own. The discovery could lead to important findings about the milky way, the star system in which our sun is located.

According to Dr. Arp's theory, when the particles crossed the space between M-82 and M-81, they were trapped in the magnetic field surrounding the latter. Some of the energy they give up in their trapped state is given off as the visible light detected in the Palomar pictures.

Said Dr. Arp, "It seems that by a stroke of good fortune a relatively nearby spiral galaxy has been recently subjected to a very unusual outside perturbation. By studying the effects of the M-82 explosion on M-81, we can learn a lot about a normal spiral galaxy.

"We can also hope to learn more about the intriguing and powerful explosion that took place in the neighboring peculiar galaxy."

The magnetic fields of galaxies are believed to play an important role in the universe, despite the fact that they are estimated to be a hundred thousand times weaker than the magnetic field on earth.

These fields are thought to be strong enough to contain most, if not all, cosmic rays within a given galaxy. They also may give rise to the general radio noise that radio astronomers have picked up from our own galaxy.

Magnetic forces are believed to be responsible for giving spiral galaxies their familiar shape.

It was not until 1962 that astronomers were able to directly measure a galaxy's magnetic field at all. At that time, Dr. R. D. Davis and a team at Britain's Jodrell Bank radio astronomy observatory measured the weak fields in our own galaxy.

THE PHYSICS STORY

New headache for physicists

Bruce H. Frisch

by Bruce H. Frisch

A LITTLE over a year ago Val Fitch (above), professor of physics at Princeton U., set out to perform a highly esoteric experiment with a nuclear particle. He has yet to get around to his original aim, because before the summer of 1964 was out, he had turned up evidence of what some scientists thought might be a fifth force in the universe (see *Science Digest*, Feb. '65).

His lab apparatus was the biggest atom-smasher in the world, the Alternating Gradient Synchrotron at Brookhaven National Laboratory, Upton, Long Island. The AGS is an evacuated pipe running through a concrete-lined tunnel one-half mile in circumference. Spaced along the pipe are electro-magnets which kick protons up to almost the speed

of light. The process begins with a trickle of hydrogen from a tank the size of a hand fire extinguisher. A relatively small accelerator—it only fills a room—picks up the hydrogen in handfuls and tosses it to a second accelerator which, in turn, tosses it into the AGS pipe at one-third the speed of light.

Several million circuits later the bunch of protons has strung out and picked up speed. At this point Fitch planned to swing the beam slowly out of its circular course and sweep it over a fine beryllium wire. The impact would send nuclear debris in all directions. Only a tiny portion would find a four-inch-by-six-inch opening in a wall of lead bricks 70 feet away. From this portion a magnet would sweep all charged particles, allowing the remaining neutral particles to continue ten feet beyond the lead to Fitch's detection gear.

In the ten-foot gap the K-zero-meson particle (K°. Zero for uncharged. Meson for middleweight.) would disintegrate into three pieces. Fitch's main objective was to force it, instead, to break into two pieces by putting a sufficient obstacle in its path. Theory said that the ten feet of air in the gap was not a sufficient obstacle. Ultimately this theory rested on a fundamental rule of physics, CP invariance.

C stands for charge conjugation, which is the switching of matter and antimatter. In a reaction, if particles are changed to antiparticles and antiparticles to particles, the reaction then pictured will be possible. In other words, making the switch does not change the law of physics.

P is for parity, which is the switching of right with left and left with right as when viewing a reaction in a mirror.

Laws of physics shaken

In 1957 Tsung Dao Lee received a Nobel Prize in physics for showing that under some circumstances the laws of physics do not hold when this switch is made. That is, the mirror images of some reactions among nuclear particles are impossible. Physicists noticed, however, that if they made a matter-antimatter switch in the mirror image, the pictured reaction was once again possible. It seemed to work in all cases, so the double manipulation became the rule of CP invariance: the laws of physics do not change if left and right and matter and antimatter are interchanged.

Although CP invariance was firmly entrenched in theory, only 225 disintegrations of K° had ever been checked to make sure it held. Fitch's secondary objective was to check many more to put a firmer experimental foundation under CP. Instead, he quickly destroyed CP invariance by detecting the occurrence of the two-particle disintegration without obstacles in place.

At first he kept it a secret. "We really sat on it and tried to kill the effect ourselves," thinking perhaps they had overlooked something,

A three-team international race to find a fifth force has ended. "This is the most important experiment in the world," said one researcher.

says Fitch. But examples accumulated until they had 45 which they reported in *Physical Review Letters* (nicknamed "Fizzrev Letters").

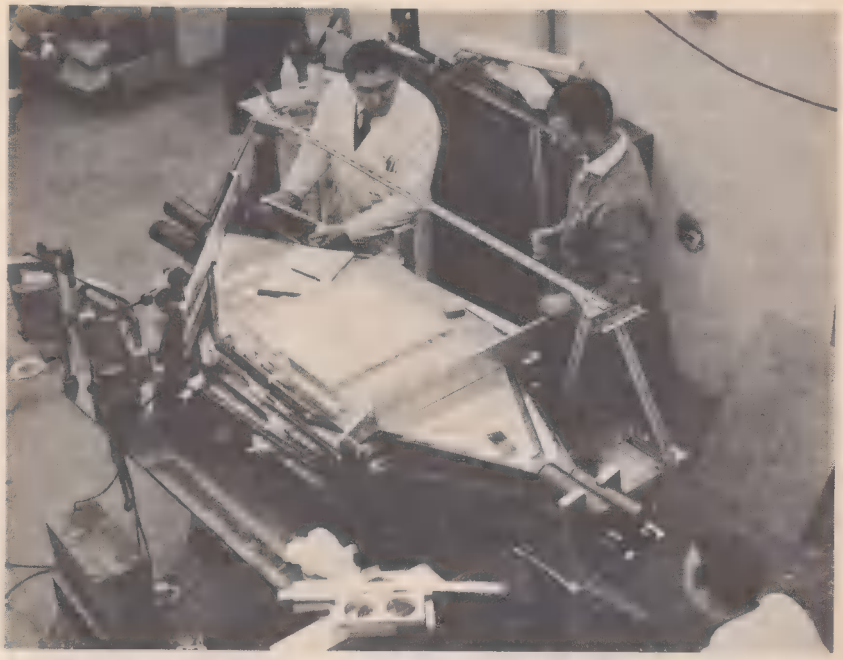
Several theoretical physicists suggested that perhaps CP invariance still held and that a fifth force was responsible. The four known forces are: (1) The gravitational force, which keeps the moon in orbit and gives us weight; (2) the electromagnetic force, which makes lightning strike and motors run; (3) the nuclear binding force, which holds the nucleus together and blows the A-bomb apart; and (4) the force of weak interactions, which is responsible for some kinds of radioactivity.

The fifth force would result from there being more matter than antimatter in our part of the universe. It would be the weakest force of all. The fifth force of the entire galaxy might be necessary to cause the forbidden disintegration.

If the fifth force did exist, K° should break into two particles more often the faster they moved. Fitch began testing this expectation by collecting many more photographs of the forbidden reaction. In the ten-foot gap the K° disintegrated into two pi-mesons, one charged negatively and the other positively, and they continued through two spark chambers.

The chambers were made of hollow plates of aluminum foil separated by spaces filled with neon and helium gases. When the plates were charged to a high voltage, sparks jumped between the plates along the ion trails. Automatic cameras overhead recorded the pattern of sparks on 35 mm. film. Since the two-pi event is rare, millions of particles streamed through the spark chambers for every desired pi-meson pair. An array of auxiliary detectors and logic circuits fired the chambers only when promising particles had gone through. Even so, as many as 300 pictures had to be taken for every true two-pi event.

Lightning sometimes jumps to the wall from this Cockroft-Walton generator, used to feed the world's largest atom-smasher.



A continental team readies a crash fifth force experiment that did in weeks what it took a Princeton group, on a relative shoestring, months to do. With a third version going on in England, this obscure experiment has taken more time and money than any other.

Wires from Fitch's gear led to monitoring instruments inside an Army truck trailer where the scientists took up their vigil. During the first part of the experiment Fitch's fellow workers had been James H. Christenson, James W. Cronin and René Turlay, but over the months they had left. Richard Roth, who had recently received his Ph.D., and James Ruff, a graduate student, joined in the work. Fitch remained, as did Wayne Vernon, a graduate student who was the team's permanent man on the spot. Since May, 1964, he and his family had lived in an apartment, furnished down to pots and pans, in a converted Army barracks on the lab grounds. During runs Roth and Ruff also lived at the lab. Whenever possible they ran 24 hours a day, six days a week. To these three the experiment became an eight-month-long tunnel. It helped to know that parallel experiments had been triggered at CERN, the European Center for Nuclear Research near Geneva, and at Harwell, England. "This is the most important experiment in the world right now as far as interest goes. People are spending more time and money on it than anything else," said Vernon.

Fitch squeezed several visits a week into a full schedule of lectur-

Experiments are going on to check whether time can theoretically run backwards. The results could threaten Einstein's theory of relativity.

ing freshmen and advising graduate students by often calling for the lab's six-seater airplane to pick him up. This shortened a three-hour drive into a 35-minute flight.

As the experiment stretched on, the second most important piece of equipment became the coffee pot. "We sort of measure the experiment by the number of empty coffee cans around," said Roth.

Quarter million frames

In March of this year Fitch decided, "We have film coming out of our ears"—about a quarter million frames—and shut down to see what he had before continuing.

The group carried the film back to the Elementary Particles Laboratory at Princeton, where six girls, housewives mostly, working half-time, scanned the frames in projectors. They knew little of what was going on; they simply looked for particular track patterns. About half the frames fitted the pattern well enough for the girls to measure the angles of the tracks for computer analysis.

By April, Fitch knew enough to announce to an American Physical Society meeting in Washington that he, CERN and Harwell had found no fifth force.

Insiders had known for months. Lee had called Fitch regularly to check early results. By the middle of February, Fitch said, "T. D. Lee already has a paper out which forgets about fifth force," and Roth had started his own experiment at Princeton to test a possible consequence.

Since the three experiments had failed to uncover a fifth force, "The feeling now is that the explanation is CP violation," said Fitch. CP had also been linked to time reversal invariance in the CPT rule. Time reversal invariance means that it should be possible for time to run backwards and events happen in reverse without violating any physical laws. CPT invariance means that events in which matter and antimatter are interchanged, which are viewed in a mirror and which run backwards in time, are possible.

If CP can change, T must change in step with it to keep CPT invariable. We know of no way to test time reversal invariance by actually reversing time. However, if T invariance doesn't hold, the neutron, while having an overall balance of plus and minus charges, should have them unevenly distributed. This is what Roth is checking. Another experiment is going on at Princeton and still others are being conducted elsewhere to test T. Eventually, Einstein's theory of relativity may tremble.

The war on cancer—1965

by Arthur J. Snider

EACH spring, cancer investigators gather at various meetings to report on their studies. Here are some of their findings:

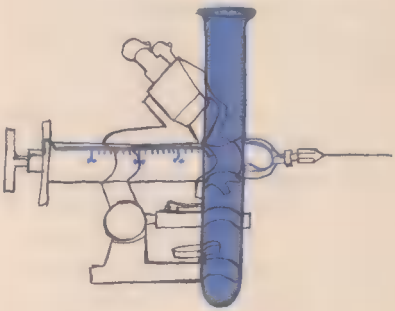
Dr. William A. Greene of the University of Rochester said there is a link between cancer and personality. In a study of 32 women with leukemia or lymphoma, he found that the illness developed while these women were "manifesting effects of sadness or hopelessness in response to separation or threats of separation from a key person, such as parent, spouse, or child."

Dr. Ernest L. Wynder of Sloan-Kettering Institute, New York, concentrated solid material obtained from city air, painted it on mice and produced cancer. But it cannot be concluded yet, he said, that these pollutants contribute to lung cancer in man.

Sister M. Rosarii Schmeer, chairman of the biology department, College of St. Mary of the Springs, Columbus, Ohio, discovered that an extract of clams is 80 to 100 percent effective in inhibiting tumors in animals. It has not been tried in man.

Dr. Edmund E. Klein of Roswell Park Memorial Institute, Buffalo, said an ointment containing the anti-cancer drug, 5-fluorouracal, showed promise when applied to 100 cancer patients.

Dr. Ernest J. Braun of Loma Linda University said heavy doses of radiation can be administered to a Hodgkin's disease patient without destroying the bone marrow, producer of the red blood cells. A cupful of bone marrow is removed from the patient's bone prior to the irradiation. The fluid is preserved at 148 degrees F. below zero. After treatment, the frozen marrow cells are re-injected into the patient's blood stream. They find their proper location and quickly multiply to their former number and perform their life-giving function in a normal manner.



Dr. Miriam Finkel of Argonne National Laboratory, Chicago, discovered a filterable agent that produces a bone cancer in mice. The discovery suggests that a new and different tumor has been added to the list of malignancies known to be caused by viruses, and lends support to the hypothesis that all cancer is viral in origin.

Dr. Stanley L. Wallenstein of Memorial Sloan-Kettering Cancer Center, New York, reported a non-addicting drug, methotrimeprazine, was found effective in relieving severe pain in 40 patients with cancer. When compared with morphine (given to the same patients), it caused less nausea and vomiting and more sedation.

Few itchy palms in Las Vegas

Las Vegas gamblers are sensitive to green but largely non-allergic to anything else.

One of the community's leading dermatologists in almost three years has seen but one case of itchy palms among casino employees handling dice, plastic chips, croupier's sticks, silver dollars or currency.

The one case was a card dealer who developed a dermatitis on the hands resulting from a detergent solution used in cleaning plastic cards.

The freedom from rashes and eczemas is not surprising to dermatologist Harold L. Boyer, for gaming workers pay careful attention to their hands. Crap-playing customers are offended by unsightly hands.

Replanting teeth

Now molars can be taken out of the mouth drilled, filled and replanted. The technique is intended as last-resort surgery where the tooth might otherwise be lost because of technical inability to treat it in position. The idea could also be used in a child whose lack of cooperation might result in the loss of a tooth.

Dr. Louis I. Grossman, professor of oral medicine, University of Pennsylvania School of Dental Medicine, has performed about 50 such operations. Age is no limitation. The oldest patient was 71, the youngest, 13.

Among the conditions calling for this approach were those in which the root canal, one of the prongs in the molar, was calcified and could not be entered with the conventional hair-like instrument. In other cases where removal and reimplantation were necessary, the root canal was extremely narrow or sharply curved. In others, the root instrument had broken off in the canal.

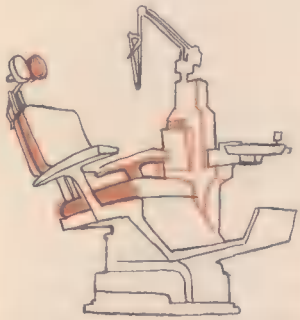
"In cases where a mouth has had extensive extraction and a back molar stands alone, intentional reimplantation can be the difference between needing just a bridge or requiring a less efficient partial plate," Dr. Grossman pointed out. "The molar is thus preserved as an anchor for the bridge."

According to Grossman, the secret in successful reimplantation is preserving the tooth and the tissue from which it has been removed.

No nibbling, says dentist

In the interest of saving your teeth, eat well but not often. Multiple feeding is blamed by a dental specialist as a principal contributor to rampant decay among Americans.

Repeated exposure of the teeth to snacks, especially those containing refined sugar, keeps the teeth under constant attack of the decaying process, points out Dr. Clinton C. Emmerson of Hemet, Cal.



Just three minutes after a food containing sugar or white flour is taken into the mouth, the decay action begins and it may last as long as two hours.

"It has been found that the average teen-age girl eats nine times a day," Dr. Emmerson said.

The sugars in the food break down and form an excellent nutrient for bacteria to multiply in. The bacteria are capable of striking at the calcium in the enamel.

In the constant nibbler, there is no chance for the mouth to rebuild its defenses. The bacteria continue to multiply and to maintain a steady onslaught.

"I would rather one eat five pounds of chocolate at one time and enjoy the two-hour decay period than spread the five pounds out over a period of time and produce almost continuous decaying action," Dr. Emmerson said.

Tiny tissue study

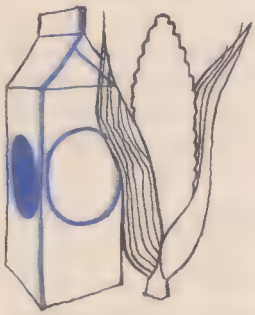
For the first time, it has been possible to study a sample of tissue as small as 30-millionths of an ounce and measure the elements in about a thousandth of that sample.

The surgically-removed tissue is rapidly frozen, sliced to a thickness of a thousandth of an inch, and dried under a vacuum in the frozen state to prevent the minerals from diffusing.

Then a laser beam is focused through a microscope onto the tissue slice and a series of pulses, each lasting about 10 billionths of a second and carrying millions of watts of energy, is generated.

This enormous light energy is condensed upon the sample by the microscope lens to instantly vaporize a tiny spot. The vapor literally rockets between electrodes. Gases in the vapor are heated to 18,000 F. to form a characteristic spectrum, or rainbow, for each element present in the tissue.

Drs. Robert Roan and David Glick of Stanford University Medical School have used this ruby laser emission spectograph to study the distribution of minerals.



Low-fat ulcer diet

Corn oil and skim milk are as effective as cream and milk in the treatment of peptic ulcer. At the same time, they reduce blood cholesterol levels by more than 20 per cent, according to Dr. Benjamin M. Kaplan of Michael Reese Hospital, Chicago.

Cream, milk, butter and eggs—the so-called Sipply diet—has been given to ulcer patients for many years because of its soft, easy digestibility. But because of their richness in animal fats, these foods are believed to increase the incidence of heart attacks in ulcer patients.

Corn oil, on the other hand, is rich in polyunsaturated fats, said to bring about a lowering in blood cholesterol. Skim milk provides the nutrients in milk minus the butterfat. The corn oil and skim milk mixture is palatable and acceptable to the patients.

Hormone helps reduce weight

Fat folks who have blamed it on their "glands" have a friend in court.

A leading Chicago endocrinologist says it may well be that obesity is tied up with a hormone disorder. He says a weight-reduction method that uses a hormone supplement along with the usual calorie-cutting diet "does more for the fat person and does it more pleasantly than any other regime that has yet been achieved."

The physician, Dr. James H. Hutton, says the supplement is chorionic gonadotrophin, a hormone derived from the urine of pregnant women and used for the last 30 years in the treatment of menstrual difficulties and other problems.

The hormone accomplishes its wonder-working in ways not yet fully understood, but apparently one of its effects is to break up fat deposits in the body and make them available for nourishment.

As a bonus, it appears to have the capacity for taking fat from places where the patient wishes to lose it, such as the hips, rather than from the face or neck where loss tends to age the appearance.

Additionally, the patients often develop a feeling of euphoria that is quite unusual and lose many of the aches and pains common to the obese, Dr. Hutton says.

The diet, which rigidly restricts fats, drops to as low as 500 calories. It permits meats, low-calorie vege-

tables, fruits and a slice of bread.

With the hormone mobilizing body fat into the blood stream, the 500-calorie diet doesn't seem to lead to any hunger feeling, the physician told a medical meeting.

"We continue the thrice-weekly injections until the patients lose the desired amount of weight," he adds. "They will lose from two to five pounds a week.

"If for four successive days they do not lose and insist they are not violating the diet, we give them an 'apple day.' For the next 24 hours they may eat up to six apples to help overcome fluid retention. Apples promote excretion."

Daily weighing is continued for at least a year after the hormone is discontinued. A meal is skipped on any day that shows a two-pound gain.

The diet was devised by a British physician, A. T. W. Simeons, who practices in Rome.

Contact lens care

When not in use, contact lenses should be stored dry. After removal from the eye, they should be washed, rinsed, then dried with disposable tissue instead of being placed in the case wet.

These are the recommendations of Dr. Margaret F. Obear, ophthalmologist at Stanford University School of Medicine, after studying the chances of getting an eye infection from bacterial contamination of contact lenses.

New burn treatments

An ointment, now becoming known as the "Lindberg Butter," appears to be effective in control of bacteria growth when applied to the surface of a burn. Bacteria growth leads to blood poisoning and accounts for a high percentage of burn fatalities. According to Col. Robert Lindberg, chief of bacteriology, Brooke Army Medical Center, Fort Sam Houston, Tex., the ointment has resulted in a marked decrease in such facilities.

Prior to the introduction of the ointment, which is basically a sulfa drug of low strength, the overall death rate was 37 percent. Now it has declined to 18 percent. Deaths due specifically to blood poisoning have been reduced virtually to zero, Col. Lindberg reported.

Another treatment innovation, reported by Dr. Frank Gerow of Baylor University Medical School, Houston, involves immersing the burned patient in a bath of silicone fluid. Patients treated over the last two years have remained in the tank from 10 to 35 days. Afterward, they are given skin grafts to repair the wound.

"The silicone immersion technique is an attempt to control the external environment of the patient, much as the artificial kidney machine controls a patient's internal environment," said Dr. Gerow. He believes that a burned patient can be stabilized by this method since he remains immersed in a constant environment.

Photo © The New York Times

The oldest canals in America

An extensive irrigation system, dating from about the beginning of the Christian era, has been uncovered in southern Arizona (above).

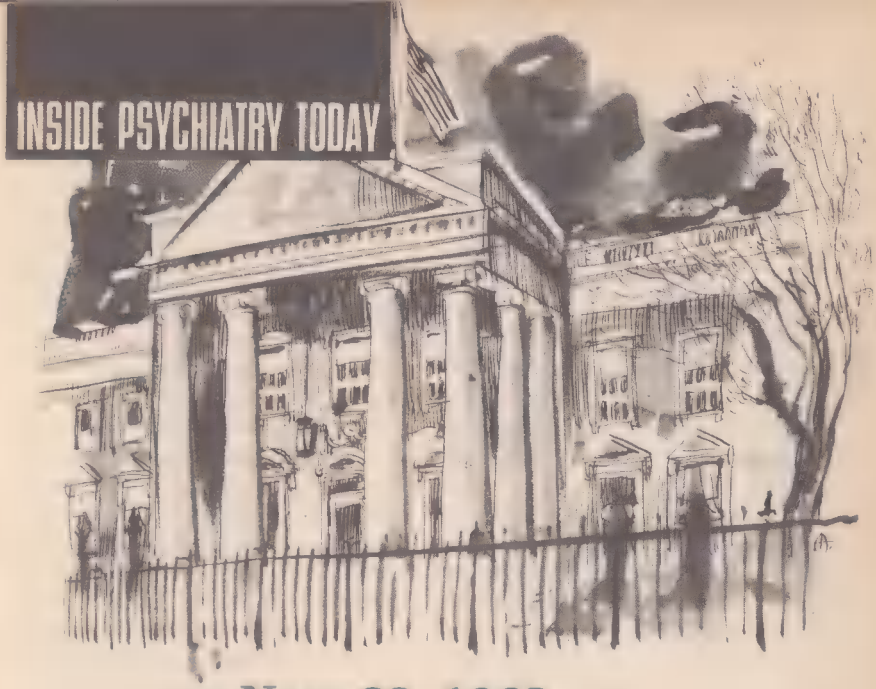
The system is 500 to 700 years older than the previously known hydraulic engineering work in the United States and it indicates that the Indians of the Southwest had a far more advanced social order than previously believed. It also indicates that the Indians probably came from an area near Mexico City where works of a similar sort and age have been found.

The canals were uncovered at Snaketown, Ariz., by an expedition from the University of Arizona. Snaketown is the site of the largest ancient Indian city in the Southwest. It had been inhabited for 20 centuries and at its height may have numbered thousands of residents.

Builders of this settlement and others in the area are called the Hohokam, an Indian word meaning "the people who vanished." Around the time of Columbus they seem to have deserted their major settlements.

Scientists think that the 7,000 members of the contemporary Pima Tribe are direct descendants of the Hohokam.

Dr. Emil Haury, director of the Arizona expedition, says the canals "suggest an immense degree of organization for such a primitive people."



Nov. 22, 1963—
a psychiatric evaluation

by Flora Rheta Schreiber
and Melvin Herman

FOUR papers presented at the spring meeting of The American Psychiatric Association (APA) put in perspective the experiences of the nation since November 22, 1963, when we underwent the shock of President Kennedy's assassination. In the first paper, "Popular Images of the President," Fred I. Greenstein, Associate Professor of Government, Wesleyan University, points to the discrepancy between the general lack of popular interest in political life and the enormous outpouring of popular feeling at the time of the assassination of President Kennedy. Research shows that:

1. The President is by far the best known figure on the American public scene.

2. The status of President is accorded great respect in American Society.

3. The President ordinarily is the first public official to come to the attention of young children.

4. Even before they are substantially informed about the President's functions, children conceive him to be exceptionally important, and to be benign.

5. Adults' conceptions of incumbent Presidents tend to be favorable, although not so favorable as

uncritical children's conceptions.

6. There is a significant tendency for citizens to rally to the support of the President, particularly when he acts in times of international crisis.

7. For at least a portion of the population, the President is the unconscious symbolic surrogate of childhood authority figures.

Citizens, moreover, seem to make psychological use of the Chief Executive: as an aid for simplifying understanding of government and politics, as an emotional outlet, as a means of vicarious participation in public affairs, as a symbol of national unity, and as a symbol of social stability.

In a paper entitled "Psychotic Visitors to the White House," Dr. Joseph A. Sebastiani of Cincinnati, Ohio, and James L. Foy, Asst. Professor of Psychiatry, Georgetown University School of Medicine, describe a wanting-to-see-the-President syndrome.

Each of the persons studied was the victim of a special type of delusional system, centering around a complexly symbolic figure, the President. The records of the 40 White House cases admitted to the D.C. General Hospital in 1960 and 1961 showed 8 admissions while Eisenhower was President and 32 during the Kennedy era. Eleven of the 1960-1961 White House cases were foreign-born. Ten White House cases have been seen in psychiatric interviews between October 1, 1963, and January 1, 1964. In general, the current White House cases were quite similar to the patients of 20 years ago. The conclusions are that the person of the President is important and that, as indicated by the higher number of foreign-born patients, there is a cultural determinant.

Threats to the President

"Presidential Assassination Syndrome" was the third paper, which was by Dr. David A. Rothstein, Staff Psychiatrist, U.S. Medical Center for Federal Prisoners, Springfield, Mo. Subsequent to November 22, 1963, the doctor began a study of patients committed to this institution in connection with offenses threatening the President. Since publication of the initial results, Dr. Rothstein has arranged to examine each new patient admitted in connection with this offense, as well as a number of patients who have not made direct threats, but who can be taken to represent borderline examples. This psychiatrist has also subsequently had the benefit of contact and discussion with members of the Warren Commission and Commission Staff, thus obtaining more complete and authoritative information pertaining to Lee Harvey Oswald than that originally reported.

The conclusions suggested by the study of President threateners, when considered in a psychiatric context, do provide clues to the understanding of Lee Harvey Oswald.

Contrary to the readily apparent explanation of these individuals'

acts as derived from hostility and rebellion against male authority figures, the study indicates that the original and deepest difficulty involves rage at the maternal object, and that the apparent resentment toward male authority is best explained as a displacement from disturbances in the maternal relationship. Identity confusion, particularly with regard to sexual role, plays a significant part. Depression and suicidal features are important, the act being simultaneously a plea for help and a suicidal equivalent.

The final paper of this series, which is by Wesley J. Liebeler, LL.D., attorney and Former Assistant Counsel for the President's Commission on the Assassination of President Kennedy, specifically treats the nature of the evidence which indicates that factors present in others who threatened the President were also present in Oswald.

To smoke or not to smoke

A study conducted at U.C.L.A. in Los Angeles shows that the support of a physician using a simple medical approach is helpful to many smokers who want to break the cigarette habit. The fact that the physician himself smokes does not necessarily interfere with his ability to help others stop or cut down on smoking.

When a girl doesn't marry

Last month, "Inside Psychiatry Today" reported on the Psychoanalytic Symposium on Marriage sponsored by the Society of Medical Psychoanalysts. This month, we return to that symposium and include also a report of a paper on the subject delivered at the APA meeting on "The Mental Health of the Unmarried." "Unmarried" means "never married," and does not include divorced, separated and widowed persons.

Despite the common assumption that unmarried women are more likely to be unhappy or maladjusted than unmarried men, the evidence points overwhelmingly to the contrary. The greater maladjustment of unmarried men is explained in part by selective migration into cities (most of the studies have been done in urban areas). It is also due to the greater opportunities for marriage granted men by their prerogative of initiative, which tends to make non-marriage in men virtually synonymous with emotional disturbance. A third factor is that a psychologically handicapped woman has a greater chance of marriage than does a psychologically disturbed man.

Both men and women who retreat from marriage indulge unconsciously in subtle maneuvers to avoid it. They will minimize the opposite sex

by fault-finding. Or they will choose a lover who is married. Or they will invent noble reasons of duty for remaining single. Some, of course, do lead single lives of dedication and that is an acceptable, fulfilling way of life.

Once we rule out a conscious and reasonable choice for being single, we are confronted with a variety of neurotic reasons for doing so. Most of these stem from fears growing out of childhood, fears of sexual relationships and of childbearing and fears of economic servitude. But whatever the reason, as Dr. Irving Bieber, Assistant Professor at New York Medical College, told the Psychoanalytic Symposium on Marriage, "Failure to marry in either sex is the consequence of a fear of it." The wish not-to-marry can run so deep that a recent study shows that even unmarried pregnant women sometimes refused to marry the fathers of their children.

It is generally believed—and Sigmund Freud himself was among the believers—that women have a greater stake in getting married than do men. This seems to be true economically, psychologically and bio-socially. Eager women, according to current belief, must somehow skillfully coax and nudge hesitant men to the altar.

What then lies behind women who don't "nudge" and men who retreat from being coaxed? Psychoanalytic experience tends to demonstrate that normally both men and women desire marriage, and that resistance to it reflects fear of it based on beliefs which somehow associate it with danger and injury to the self. "There is increasing recognition," Dr. Bieber declared, "that bachelorhood is symptomatic of psychopathology and that even though women may yearn for a husband, home and family, they withdraw from fulfilling their wishes because the anxiety they associate with marrying is more powerful than their desire for it."

Anxiety

What is the source of such powerful fears that conflict so strongly with fundamental desires? These fears may spring from pathologic dependency induced by a mother, perhaps in the absence of a father or in the presence of an inadequate father who could not be consistently depended upon to provide protective support for his daughter. Guilt-provoking mothers frequently raise daughters who are incapable of tolerating a situation like marriage. Surprisingly, early traumatic experience is not a block to marriage, according to clinical experience, Dr. Bieber reported. For, according to the evidence, even women who had brutal fathers but reasonably good maternal relationships tend to marry. At any rate, childhood figures strongly; so insistently that Dr. Saul H. Fisher, Associate Professor of New York University School of Medicine, regards a fear of repeating the bad home life of one's childhood as marriage-phobias' chief cause.

Some women—a very small group—do not marry because they fear sexual relations so much that they avoid men. This fear is so great that Dr. Biever noted that he had come across "three cases of women who remained virgins even though they did marry." Other women avoid marriage because they fear bearing and rearing children. Such women will sometimes marry after passing the child-bearing years.

Men mirror many of the fears of women—except, of course, the child-bearing one—and add one of their own, the economic. When inhibitions about their work seriously sap these men's confidence about the consistency of their performance, they fear the demands placed on them by marriage and families. Some men feel that marriage means economic servitude and limits their occupational mobility.

Music and emotion

"Music and Human Emotions," a paper from the University of Kansas, makes the point that music, being a form of nonverbal communication, offers itself as a vehicle for many different associations, attachments, signals and meanings. Many of these meanings or feelings elude language and the same music may elicit diverse responses in different people. However, there is nearly always some generality in the effect of a musical selection.

Why man fights

It is not surprising to find one of the APA sessions addressed to the subject of conflict—the mainstay of drama and also an essential of life. Psychiatry Professor Robert Waelder, of Philadelphia's Jefferson Medical College, in "Benign and Malignant Conflict" raised the questions of what issues, under modern conditions, are likely to lead to organized large-scale violence—to international or civil war. It has been widely held that wars are rooted in economic conflicts. This paper asserts, however, that the position is untenable since economic conflicts are rational, whereas war, as we have known it, involves nonnegotiable conflict.

Dr. Jacob A. Arlow, Clinical Professor of Psychiatry of the State University of New York, takes us into "The Reaches of IntraPsychic Conflict." This kind of conflict, he maintains, is rooted in man's biological nature and in the fact of his existence as a social being. Civilization at once intensifies the propensity for the conflict and provides models for its resolution. The principal methods used in conflict mastery and resolution are renunciation, displacement, transformation and institutionalized group discharge. The dynamics of conflicts within groups, in turn, bear certain similarities, but also fundamental differences when compared to conflict within ourselves.

What we'll see on Mars

When Mariner 4 shoots television pictures of Mars over 100 million miles in space and sends them back to earth, it will provide humanity with the first close-up look at another planet.

Parallel lines show the path Mariner 4 will take as it passes surface of Mars.

by Bruce H. Frisch

At 8:25 p. m. Eastern Standard Time on July 14, Mariner 4 will start shooting television pictures of Mars over 100 million miles out in space and sending them back to Earth.

It will provide humanity for the first time with a close-up look at another planet.

What will it find? Most intriguing of all—will it indicate the possibility of life on Mars? Some scientists think not.

"In looking for life on Mars we could establish for ourselves the reputation of being the greatest Simple Simons of all time," wrote Philip H. Abelson, editor of the American Association for the Advancement of Science journal *Science*, early this year.

Yet, at one time even the idea of intelligent life on Mars was the accepted scientific opinion.

Sir William Herschel, the great British astronomer, reported to the Royal Society in 1784 that Mars' "inhabitants probably enjoy a situation in many respects similar to our own."

A little over a century later, the rich and proper Bostonian, Percival Lowell, devoted his life to observing Mars. He thought he saw, "hints at the existence of beings who are in advance of, not behind us, in the journey of life."

Even in this skeptical age, the theories are, if anything, more fantastic. Calculations made in the

1940's revealed that Phobos, the inner of Mars' two moons, was spiralling in toward the planet faster than could be explained by any known force such as air drag. Iosif S. Shklovsky mulled this over. He is head of the Department of Radio Astronomy at the Sternberg Astronomical Institute in Moscow and a man of what one interviewer called "uninhibited intellect." Air drag would explain the mystery, he decided in 1959, if Phobos were hollow. And if this were true, maybe it was an artificial satellite, he continued. Millions of years ago, when the oceans dried and oxygen diffused into space, the men of Mars may have taken refuge in an orbiting space station.

At least one other scientist takes Shklovsky seriously, but moves the launching date up a bit. Phobos and Deimos were discovered by Asaph Hall at the U. S. Naval Observatory in Washington in 1877. When Mars was closer, in 1862, larger telescopes had been trained on it but missed its moons, notes Frank B. Salisbury, professor of plant physiology at Colorado State U.

"Should we attribute the failure of 1862 to imperfections in the existing telescopes," he asks, "or may we imagine that the satellites were launched into orbit between 1862 and 1877?"

Taking into account other evidence that makes intelligent beings on Mars possible, he claims, "we should at least try to keep our minds open so that we could survive the initial shock of encountering them."

When Salisbury was at Cal Tech in 1953, among the group with whom he ate lunch was Sanford Siegel, now testing life in simulated Martian environments at the Union Carbide Research Institute, Eastview, N. Y.

"We had a game of trying to imagine a completely different form of life," says Siegel. After seven years' work, Siegel has a good foundation for some of his imaginings. He says, "I would expect to find life anywhere the temperature goes above zero degrees Centigrade [freezing] sometime in the year," in spite of the harsh Martian environment that Abelson and others gruesomely detail.

Atmosphere of Mars

Mars is assumed to have some kind of atmosphere, because our view of it is occasionally blotted out by what look like dust clouds and haze, and the edge of Mars is fuzzy as if seen through a blanketing gas.

Trying to pin down how much and what kinds of gas make up the atmosphere has proved difficult. The logical way is to study the sunlight reflected from Mars. As the light passes through the Martian atmosphere, the various gases absorb certain colors. When we pass the reflected light through the prism of a spectroscope, it spreads into a rainbow, with dark gaps where the absorbed colors should be. Unfortunately, the strong effect of our own atmosphere completely

Biologist Siegel thinks the environment of Mars would push development of higher forms of life, rather than limit it to its simplest forms.

overpowers the weak effect of distant Mars. At the time of the close approach of Mars in 1963, however, measurements were taken from an approaching and receding Mars so that the Doppler shift of the dark lines moved them from behind the dominant Earthly ones.

Martin Schwartzchild, Princeton U. astronomer, took a different approach in project Stratoscope II by hoisting a telescope by balloon above 98 percent of the atmosphere. Each approach produced slightly different results, but both showed a minute amount of water vapor and a large percentage of carbon dioxide compared to Earth. The values chosen by NASA and labelled "speculative" are 0.14 percent water vapor and 2.2 percent carbon dioxide. The balance of the atmosphere, based on reasoning, but on no direct physical evidence, is nitrogen, 93.8 percent of the total, and oxygen, 0.14 percent. Most authorities also include a trace of argon.

The thinness of the Martian atmosphere presents an even more lugubrious picture. Beginning with measurements by the French astronomer, Audouin Dollfus, who put the surface pressure of Mars equal to that at 50,000 feet on Earth, estimates have steadily dropped. Last year, Gerald P. Kuiper, head of the Lunar and Planetary Laboratory of the U. of Arizona put the pressure at the equivalent of over 100,000 feet.

Add to this a killing temperature range. From the various available reports, NASA chooses an absolute high of 86° F, which would occur after noon at the equator during the summer, and an absolute low of —184° F. The high may be accompanied by an estimated nighttime low (we cannot see the dark side) of —95° F.

Adaptability of life

Through the succession of gloomy observations, Siegel keeps smiling. In his Mars simulator, he has seen seeds germinate, seedlings grow and plants survive for 300 days in an environment that most biologists would consider lethal. He has watched mealworms live for 10 weeks and molds thrive. Out of his experience has grown an enormous respect for the adaptability of life. But his basic argument for life on Mars is the modern theory of how life evolved on Earth.

At the beginning, our atmosphere was much different from today's according to a new synthesis by two noted researchers. They are Lloyd V. Berkner, head of the Graduate Research Center of the Southwest in Dallas and Lauriston C. Marshall, an engineering physicist and

chief of scientific personnel at the Southwest Center for Advanced Studies.

Our early atmosphere, they say, was primarily water, carbon dioxide, hydrogen, methane and ammonia. From these raw materials, organic chemicals were produced by lightning flashes, as has been demonstrated in several labs on a limited scale. Eventually the right reactions took place in a soup of these chemicals to create a combination that could reproduce itself—a molecule of living matter.

Earth's primitive atmosphere exposed life to killing ultraviolet light, so that probably life at first was limited to fungi, bacteria and algae that held on at the bottoms of deep, volcanically heated pools. The oxygen they produced slowly accumulated in the atmosphere. Part of it was turned by ultraviolet rays into ozone, O_3, which shields the surface from ultraviolet. At that moment in time, about 600 million years ago, the oxygen level was reaching about one percent of its present level, sufficient for life to abandon fermentation as a way of obtaining energy for the much more efficient method of respiration. This coincidence, Berkner and Marshall believe, touched off an evolutionary explosion in the oceans.

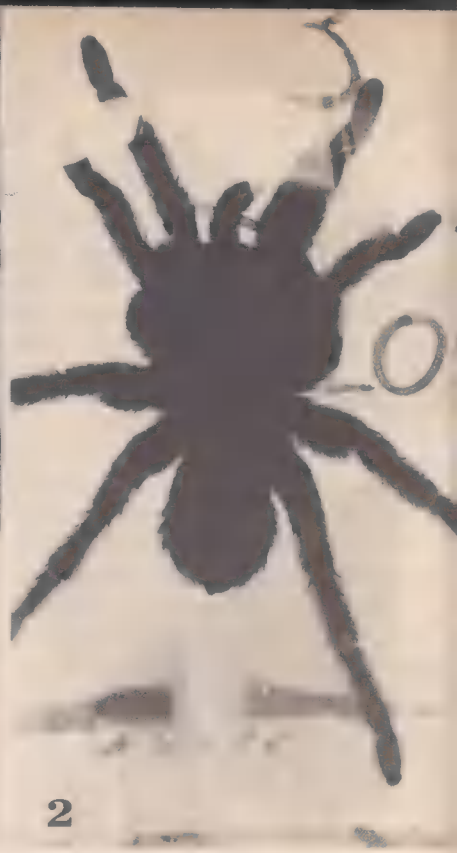
The atmospheres of the planets are thought to have been similar at the beginning of their histories and to have later diverged. "Up to a point, therefore," says Siegel, "the chemistry and development of proto-life on Earth and its neighbors may have been similar. Each, however, eventually went its own way. As a biologist, it is my firm conviction that if life got any foothold at all, it is likely to be there now."

In fact, he thinks the environment of Mars would push the development of higher forms of life rather than limit life to its simplest forms. "On Earth, wherever you find acute stress you find complicated organisms. One thing a high form of life has is experience in combatting tough conditions," Siegel says.

Asked about the scarcity of water on Mars, Siegel suggests that there are perhaps saturated brine pools that would not evaporate at high temperatures or freeze at low ones. He notes that bacteria on earth can live in saturated brine.

(Text continued on page 50)

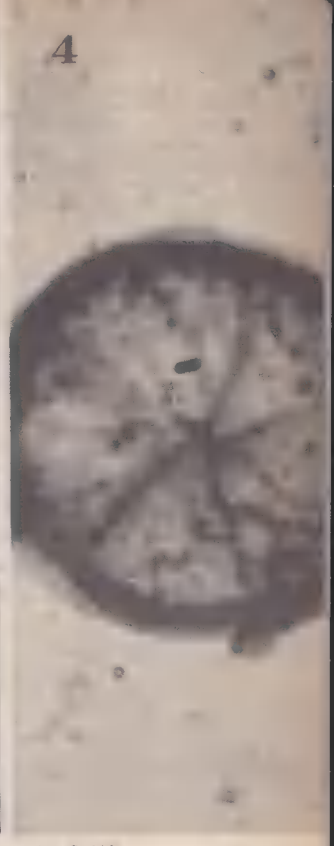
The 575-pound Mariner Mars spacecraft will travel a flight distance of 350 million miles, taking eight and a half months.



1 2

photos by Bruce H. Frisch

Mars life? "Yes." So says biologist Sanford Siegel (1) after a three-stage test of the adaptability of life carried out at the Union Carbide Research Institute. In stage one, he switched organisms from one Earth setting to another. For instance, in the lab he put desert plants under water. In stage two, he lifted Earth life to the edge of space. Flora the tarantula (2) is livelier at the equivalent of 40,000 feet than at sea level. Nothing on Earth lives permanently above 20,000 feet. At 55,000 feet, dime-store turtles (3) survive 14 weeks. Up to 90% of their blood disappears, leaving brown sludge. Their hearts beat, but there can be no circulation. Yet, they swim and walk. Finally, Siegel simulated a Martian atmo-



Union Carbide

sphere: nitrogen, with some carbon dioxide and traces of oxygen and argon at 1/10 to 1/100 sea level pressure. Some plants lasted a year. Colorful molds often throve on their remains. One unknown creature (4) in a soil sample outdid them all. Placed in a mixture of methane, ammonia and oxygen, like the primitive atmosphere of Earth must have been, it grew. Later it was noted to be similar to the oldest fossil yet discovered—age: two billion years. Some modern life also survives, perhaps by "genetic memory." Mars may have had a similar early atmosphere, even though its present one may be harsh. "Life, wherever it starts," says Siegel, "will be shaped by the action of its surroundings, no matter how exotic."

On the basis of life tests in the simulator, we should have at least an open mind on the possibility of Martian or extraterrestial life.

(Text continued from page 47)

In addition, it is probable that a slight amount of water is tied up in the white, gossamer-thin polar caps. Their content was identified as water in 1948 by their infrared spectra. At NASA's Ames Research Center, Moffett Field, California, scientists reproduced a model of the ice caps in their Mars simulator. They found them to be the visible portion of an ice line that dipped underground away from the poles. At the edges of the model caps they found some liquid. Usually it is assumed that the caps wane by sublimation, that is, passing directly from solid to gas at below-zero temperatures.

The significance of these tests is hard to judge, admits Richard S. Young, chief of the exobiology division at Ames. On the basis of life tests in the simulator, however, he claims we should "maintain an open mind on the possibility of Martian or extraterrestial life."

A possible way out of the apparent Martian water shortage has been described by Joshua Lederberg, winner of a Nobel Prize in Medicine and Physiology, and Harvard astronomer Carl Sagan. They suggest that any water saved from sublimation by being frozen underground might be thawed in pockets around hot springs, fumaroles or other volcanic action.

Then, again, asks Siegel, why couldn't organisms use sulfur instead of water in photosynthesis (such organisms may account for the Gulf Coast sulfur deposits) to reduce their dependence on water, and, incidentally, help account for the lack of oxygen in the atmosphere?

Ultraviolet light

The shortage of oxygen brings up the problem of ultraviolet light. Although Mars lacks enough oxygen to provide a protective ozone layer, photographs taken through a blue filter do not show the surface. This means that something else in the atmosphere blocks out the blue part of the spectrum—most of the time. At opposition, when Earth is directly between the sun and Mars, the atmosphere often clears suddenly and dramatically, laying open the surface to the deadly rays.

In response, Siegel notes that a shallow layer of brine or a crust on a brine pool could furnish shielding, and that ultraviolet may not be as fatal as we earthlings believe. Reindeer moss that he exposed to 4,000 times the normal day's dose came through little damaged.

Life would still have to fight off a rain of cosmic rays possibly 1,000 to 10,000 times that on earth. Siegel counters, in part, with the observa-

tion that radiation damage of all kinds is less with low oxygen.

As a matter of fact, Siegel seems to have an answer for everything "There are a lot of biological tricks," he chuckles, but admits, "I'm sticking my neck out."

Siegel's view

Strong support for Siegel's view came this spring from a panel of distinguished scientists formed by the National Academy of Sciences at the request of NASA. "Given all the evidence presently available, we believe it entirely reasonable that Mars is inhabited with living organisms and that life independently originated there," they reported.

No direct evidence, however, has ever been found to back them up.

For a brief time, from 1956 until this year, it looked like there might be. William M. Sinton, then of the Harvard College Observatory, thought he had found absorption lines in the infrared spectrum indicating organic chemicals, particularly aldehydes. He withdrew the claim in January after being convinced the lines probably came from heavy water in the Earth's upper atmosphere.

The strongest indirect evidence of life is the seasonal color changes. Even during the Martian winter, some areas, called maria or seas, are darker than others, called deserts. On arrival of the southern spring, the one we see at closest approach, a dark band surrounds the shrinking polar cap. The darkening spreads into the maria and moves north at 28 miles per day until it reaches 40 degrees north latitude.

Many have interpreted this as a wave of awakening vegetation nourished by the melting polar cap, even though the cap is probably only a coating of frost and sublimes anyway. But killjoys have come up with completely nonvegetable explanations.

One piece of evidence that would silence the whole argument is the detection of chlorophyll in the dark areas. Repeated attempts since 1924 have failed, but no one regards them as the final word.

Not only did Percival Lowell believe there was vegetation on Mars; he believed that it was planted and irrigated in strips along the canals by intelligent beings. Today, the very existence of the straight lines, whatever their origin, that could be called canals is in doubt. Dollfuss claims that when the seeing is very good they break up into a series of small markings.

Canals

The mystery of the canals could be cleared up this month by Mariner 4. She will take and store, on tape, 21 pictures that will be transmitted to Earth between July 14 and 15. The pictures will fall on a line running 4,000 miles southeastward from the northern to the southern hemisphere. At the beginning of the run she will be 8,400 miles above the surface, and at the end, 6,300 miles. She will continue

Associate director of the Griffith Observatory and Planetarium in Los Angeles says, "It is more fun to have life on Mars than not to have it."

in to 5,400 miles on the dark side before heading around the sun.

Because the distance is so great —134 million miles—and the radio power so limited, it will take 20 minutes to transmit each picture back to earth. But they will be about as good as the pictures of the moon we take from Earth.

The last picture will cover an area 150 miles on a side and show objects as small as a little over a mile across.

As Mariner 4 curves behind Mars, the way her radio is cut off will also tell us something about the Martian atmosphere.

Two days after Mariner 4 was launched last November 29, the Russians sent their own Zond 2 chasing after her. Zond 2 will arrive at Mars around August 6—to do what, the Russians never said. Early in May a visiting Soviet scientist said her radio had gone dead after wavering for a month.

Mariner 4 will be the last Mariner shot. NASA cut off the program to make way for a much more ambitious project called Voyager. Until January, Voyager was parked in the planning orbit. Then NASA asked industry for preliminary designs aimed toward possible launching in 1971. This means we will be only spectators at the next two Mars oppositions in 1967 and 1969.

But in 1971, we will send the four- to five-ton Voyager into orbit around Mars to drop a capsule that will ease to a soft landing by retrorocket. Inside the capsule will be a life detector.

Of the dozen or so detector candidates, one of the furthest developed is Gulliver.

Three miniature cannons on Gulliver fire projectiles trailing kite string coated with grease. The strings are reeled in coated with bits of soil and immersed in a nutrient broth tagged with radioactive carbon. Microorganisms in the soil, if any, then will feed on the broth, giving off carbon dioxide which can be detected by Geiger counter.

Life detector

The idea behind detectors like Gulliver is that if there is large life there anywhere on the planet, there will be microorganisms everywhere. Gulliver has already detected life here on Earth on a barren mountain top, in Death Valley and in a salt desert.

It could detect life on Mars, too, only to find that the organism was a colonizer from earth, brought aboard an imperfectly sterilized spacecraft. Disappointing, yes, but not nearly as dangerous as the opposite. Martian life, carried inadvertently on a returning spacecraft,

could sweep over earth like rabbits over Australia.

But what if Gulliver plunged into one of Siegel's Martian brine pools, or the form of life on Mars did not give off carbon dioxide? "The best life detector," Siegel asserts, "will be a man."

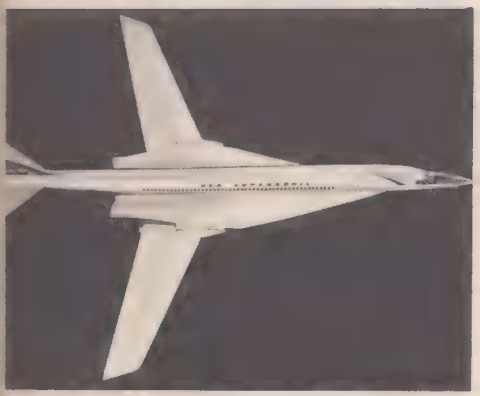
The United States is definitely moving toward sending a man to Mars. At a spring scientific meeting, Franklin P. Dixon, director of manned lunar and planetary mission studies for NASA, said, "Expeditions to the planets are the ultimate goal of manned space flight in this century."

One study contract given to Douglas Aircraft placed the hypothetical trip in the decade after 1975. Three to ten astronauts would make the one- to three-year voyage. Some of them would spend 10 to 50 days on the surface.

Expensive projects like this in the name of science anger some scientists like Barry Commoner, professor of plant physiology at George Washington U. in St. Louis. There is no evidence of liquid water on Mars, he points out, and "if liquid water is lacking on Mars, there is no reasonable basis for the expectation of life and no good reason to design instruments to seek it." A majority of scientists, however, while laying no bets, would probably agree with Robert S. Richardson, associate director of the Griffith Observatory and Planetarium in Los Angeles. "Let's admit it," he says. "It is more fun to have life on Mars than not to have it."

THE AIR PICTURE

Did we goof on the SST?



Wide World

Model of Boeing's SST shows craft's variable sweep wings in low-speed position.

THERE has been a lot of criticism of the United States' approach to building a commercial super-sonic transport (SST).

Many think the U.S. effort is moving too slowly. Others think we should not bother building an SST at all. The debate has been sharpened in recent months by two developments.

First, there is now no doubt that a joint British-French super-sonic airliner will be built. In spite of early British Labour Party reservations, the Concord (or Concorde, depending on whether you are on the English or French side of the project) has solid backing and is well on its way. Officials connected with the project enjoy showing reporters through a full-scale mockup of the Concord at the British Aircraft Corporation's plant near Bristol. This wooden mock-up will soon be duplicated in aluminum. BAC expects to have a prototype flying in 1968.

The second sharpening factor in the debate was the release of the results of a test on sonic booms run by the Federal Aviation Agency over parts of Oklahoma and New Mexico.

A sonic boom results when a plane exceeds the speed of sound and begins pushing the air ahead of it into convulsive shock waves. The shock wave follows along the flight path of the plane and exerts sound and air pressure on the ground below.

The FAA said that its tests showed that the intensity of the boom was less than expected. Yet there were thousands of complaints, and citizens of the area have already collected $13,000 in property damage due to boom vibrations. Most people indicated they could live with the boom, but a solid 27 percent of those questioned said they could not.

A number of ideas for reducing the force of the boom have been advanced, but there is little doubt that it will remain a big problem.

TWA, Pan-Am, American and Continental have already placed

orders for the Concord, which may be zipping passengers from New York to London or Paris in less than 3¼ hours by 1970.

American SST will be two and perhaps as much as four years behind the Concord. (Also possibly behind the Russians, who may take to the skies soon with a modified military plane as their SST entry.)

Anglo-French advantage

Two American manufacturers—Boeing and Lockheed—are working on designs for an SST. They hope that by producing a faster SST the Anglo-French advantage can be overcome.

Originally, the Concord was scheduled to fly at Mach 2, or twice the speed of sound. America hopes to produce a Mach 3 (three times the speed of sound) plane. The American SST will be constructed of titanium, a metal that has just recently been made usable. It will be able to withstand the higher temperatures generated at Mach 3. The Concord will be made of aluminum, a throughly tested airplane material.

Wayne Thomas, aviation editor of the *Chicago Tribune*, wrote that the Concord will have a cruise speed of Mach 2.2 (1,450 mph), and this will be "only a trifle lower than the American SST's now on paper. The latest word from the FAA is that both the Boeing and Lockheed SST programs call for Mach 2.6 to 2.7 (about 1,800 mph) cruise speeds.

"A comparison of flight plans for both the Concord and the American planes shows the meaning of these differences. The Concord would require 15 to 20 minutes longer on an eastbound flight between New York and Paris, and possibly 25 minutes longer on the westbound trip.

"Neither plane could make the 3,600-mile trip in less than 2 hours and 20 minutes. Difference in flight times could well be lost through air traffic control directives to crews at either take-off or arrival."

British critics have claimed that the Concord has forced American aviation companies into a position of biting off more than they can chew in order to gain a competitive advantage. Americans say the greater speed, plus the greater seating capacity of the U. S. planes, will give them a very real lead.

The biggest question mark in the entire SST picture is how the public will react to super-sonic flight. There have been warnings about potential dangers of SST's plus a general uneasiness about the need to go that fast in the first place. Public acceptance must be high because the program is enormously expensive, and the SST's must compete with the very good sub-sonic planes we have today and the even better ones we will have tomorrow.

Still there is a curious unreality about the whole SST debate—for the planes won't be built and flying until sometime between 1970 and 1975. But the chips are already down and the wheel is turning.

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TIPS AND TRENDS

THE WAY TO A MAN'S STOMACH IS HIS BRAIN. So goes the theory behind a new drug you'll be able to get for weight control. Developed by Warner-Chilcott Laboratories, the drug acts on the satiety center of the brain (hypothalamus). By blocking impulses to it, the drug can cause you to lose interest in eating. But it doesn't stimulate the central nervous system. The drug is called Pre-Sate.

NEW WAY TO FIGHT CHOLESTEROL. Still in the experimental stage but promising, a compound called cholestyramine has been found to cut blood cholesterol levels sharply. The drug removes bile acid from the body. Since the liver needs cholesterol to make bile, it draws on the cholesterol you already have. The experimenter: Dr. Theodore van Itallie, of St. Luke's Hospital, New York City.

SCIENCE MANPOWER BOOM AHEAD. A Smithsonian Institution guess has it that America in the next five years will have one million more scientists, engineers, technicians.

SHOULD YOU BUY THE NEW RADIAL-PLY TIRES? Yes, if you want 50-100 percent more wear and can pay about 30 p.c. more. With cords that run at right angles, the radial-plys are also safer and save fuel. Catch: They prove somewhat bumpy at slow speeds.

CIGARETTE FILTERS WORK. Roswell Park Memorial Institute in Buffalo found tars from filtered smoke caused half as many skin tumors in mice as non-filtered smoke.

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Scientific secrets of fitness

by Andrew Hamilton

THE middle-aging language professor was overweight and flabby. By midafternoon, he frequently grew irritable and tired. Because the effort was too great, he had put aside the textbook he was writing. He and his wife were childless and they had practically given up any hope of becoming parents.

"I have a mild but scientific program of weight control, posture and muscle tone that may help," suggested Dr. Laurence E. Morehouse, professor of physical education at the University of California, Los Angeles.

Within six months, the language professor's students noticed that his lectures were more interesting. He started working on his book again and prospects for promotion seemed brighter. He even announced that his wife was expecting a baby.

Statistics that have come to light in recent years illustrate the shocking state of this country's physical health. At least 10,000,000 soft-living Americans suffer from disorders of the heart or blood vessels,

A high speed motor-driven treadmill is used by Dr. Morehouse, professor of physical education, to determine the physical activity for which a subject is best suited.

and one-quarter of all men between the ages of 44 and 65 who die this year will do so because of some form of heart disease.

The same concern is held for younger people. About 50 percent of the draftees are rejected on physical grounds. Researchers tell us that an inactive man's body reaches "middle age" physiologically not at 45, but at about 26.

America's success in the Olympic Games and in other sports is sometimes hailed as a triumph of our fitness. But compare two teams of superbly-conditioned young men on the football field or baseball diamond with thousands in the stands and millions watching on TV.

Yet there is interest on the part of the public. And perhaps it can be guided properly. A small but dedicated band of medical, nutritional and physical-education authorities have been trying to encourage this interest. The late President Kennedy's physical fitness program was one example. Another is scientific research on the secrets of staying fit —such as Dr. Morehouse's Human Performance Laboratory at UCLA.

With a Ph.D. from the State University of Iowa, Dr. Morehouse was a naval officer in World War II, then conducted research at the Harvard Fatigue Laboratory and at the University of Southern California before coming to UCLA 10 years ago.

Working with other physical education authorities, graduate students and industrial and governmental researchers, he has attempt-

Weight training is the fastest way to develop strength. If exercise is supervised and weights do not exceed 50 lbs., it is an excellent way to keep in shape.

ed to find out just what makes the human machine tick—and how to make it tick better.

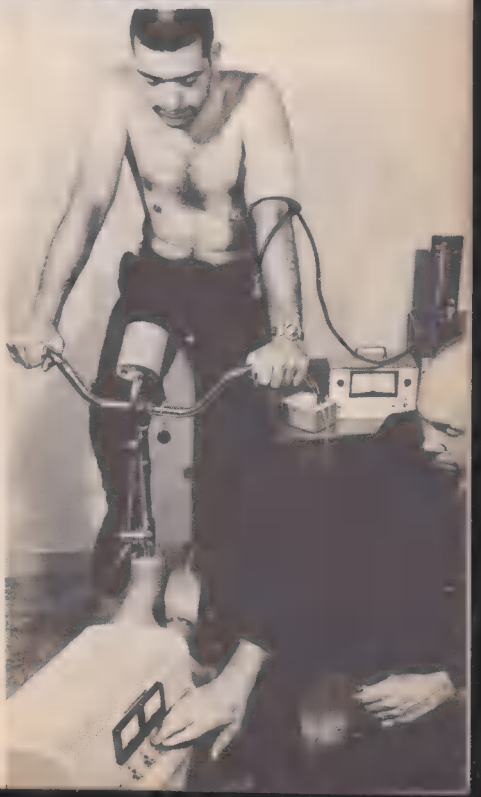
"Too much sitting—in our automobiles, at our desks and on our living room sofas—is the great evil," he says. More than any one thing it has made a nation of softies out of us.

"The average man or woman doesn't need to be as well-conditioned as a professional football player or ballet dancer. But he does need to stretch his muscles and stir up his blood circulation if he wants to do his best and beat the life insurance statistics."

Here is Dr. Morehouse's conditioning program for the average man or woman, boy or girl. It is based on scientific research. It doesn't require expensive drugs,

Photos by Don Battle

Above: Lax stomach muscles are strengthened and toned by use of slant board. Right: Dr. Morehouse tests subject's heart response while on bicycle ergometer.



elaborate exercising machines or trips to the gymnasium. But it does demand a measure of will power. And when will power is applied, the program is surprisingly successful —as hundreds of individuals will attest.

1. *Weight control*

The first step is to bring your weight under control. Dr. Morehouse recommends a program that will reduce your excess poundage one or two pounds a week. Anything more drastic should be attempted only under your doctor's supervision.

After a week of moderate eating, you start stepping on the scales every morning. If your weight is

Many doctors believe that tension is a prime cause of heart disease. Tension can be reduced by taking a few minutes a day for relaxation.

still above the hoped-for level, you skip all extra-caloried foods and liquids that day—soft drinks, candy bars, rich desserts, etc. If your weight is below expectations, you may eat gravy on your potatoes, mayonnaise on your salad or ice cream on your cake.

Big breakfast

Moderate dieting, says Dr. Morehouse, is not difficult. One way to keep down the flab is to eat a big breakfast, a moderate lunch and a light supper—with no snacks between meals or at bedtime. Generally speaking, excess calories taken aboard during the evening turn into fat rather than energy. If you can't get along without pie, eat it at breakfast, advises Dr. Morehouse.

2. *Posture*

Posture is important to physical fitness. Many individuals can improve their posture by remembering two simple tricks. First, level the pelvis. Second, raise the breastbone.

The reason why many men develop a paunch—and women too—is that when they sit, the contents of the abdomen spill forward. This causes the ligaments in the front to shorten and those in the back to lengthen. But if you tip the pelvis back, you balance the contents of the abdomen and strengthen the ligaments.

Professional fashion models practice this secret of good posture and you can too. Pay particular attention to your pelvis when walking. In time, you may take off two inches around your middle; and if you are not overweight, the paunch may disappear altogether.

The second posture trick is to raise the chest slightly. This elevates the breastbone and allows your head and shoulders to relax. Upon learning this trick, one man told Dr. Morehouse, "I may be crazy, but standing straighter makes me feel more alert and more optimistic."

3. *Walking*

One sure way to build muscle tone and improve circulation is to walk, walk, walk. Instead of driving your car to the corner drugstore, walk. If your office or classroom is on the third floor, shun the elevator and climb. On weekends, hike in the country or in the park.

Walking, says Dr. Morehouse, should not be just a leisurely stroll, but a brisk workout—remembering to hold the pelvis level, the breastbone up and let the arms swing.

4. *Regular exercise*

Walking should be combined with a program of exercise—not necessarily strenuous but *regular*. Week-end activities such as bowling, golf or gardening are fine, but they should be combined with 10

minutes of calisthenics on Tuesdays and Thursdays.

The old touch-your-toes routine is passé. Instead, Dr. Morehouse suggests these three basic exercises:

(a) To strengthen stomach muscles, lie on your bed and draw your knees up to your chin 12 times. Or, sit on the floor, hook your toes under the bed and do 12 sit-ups.

(b) To tune up arm and shoulder muscles, do 20 push-aways from the wall. Later on, you can try push-ups from the floor.

(c) To exercise leg muscles, dance or run in place about 30 quick steps. This might be increased to 200 or more.

5. *Relaxation*

You might suppose that anyone sitting down is relaxing, but such is not true. A business or professional man may not have walked more than 100 feet during the day—yet be exhausted at quitting time. Many doctors believe that tension is a prime cause of heart disease.

Dr. Morehouse advises that tension can be reduced by taking a few minutes here and there for relaxation. Stand up and stretch, relax during a coffee break, take a nap after lunch. When driving home, if you come to a red traffic light, loosen your grip on the wheel and let the tension drain out.

Because anxieties build during the day, many people find it difficult to fall asleep quickly.

"If everyone would follow these few simple rules," says Dr. Morehouse, "we'd all feel better, look younger and live longer."

Sovfoto

This is the complex radio telescope with which astronomer Gennady Sholomitsky was reported to have picked up signals from an advanced extraterrestrial civilization.

Those wild Russian stories

by Daniel Cohen

WHEN four embarrassed Soviet astronomers called a hurried news conference to deflate the story that they had discovered radio signals from a civilization in outer space (see *Science Digest*, June '65), they put a quick end to one of the best-publicized in a long series of wild Russian science stories.

Wild science stories have been coming out of Russia regularly for years. They are so numerous that Soviet scientists have been complaining in their journals that the reports are making them a laughing stock all over the world.

These wild stories fall into three main categories.

The first is the out-and-out fake. In this category is the story that several women had been found who could read a printed page with the tips of their fingers. What had happened is that researchers were fooled by an old carnival trick. Before they found out they had been duped, the story of finger sight had been publicized all over the world and had stimulated research in other countries like the United States. Very few who were enthralled by the idea of reading with fingertips will ever hear how the story really began.

Another story in this category is the one of the 5,000-year-old salamanders that had been found frozen in Siberia and revived by scientists. How did it start? An enthusiastic

reporter got the idea out of a children's book.

A second category consists of mistakes or garbled reports. This classification includes a recent story that the bones of an Abominable Snowman had been found in the Caucausus Mountains. When the bones were finally examined by experts, they were found to be those of ordinary *Homo sapiens*.

And a garbled report from Siberia's remote Lake Baikal resulted in the story that a 100-million-year-old reptile was found swimming around there. Just not so, it developed.

The third and most important type of story consists of scientific speculation treated as proven fact. The signals-from-other-civilizations story comes under this heading.

For several months, Gennady Sholomitsky, a radio astronomer, had been studying the emissions coming from a stellar radio source known as CTA-102. He found that the waves flickered in a pattern that was repeated regularly every 100 days.

Then Dr. Nikolai Kardashev, a 33-year-old astronomer from the Sternberg Astronomical Institute, was supposed to have told reporters from Tass, the official Russian news agency, that signals from an extra-terrestrial supercivilization had definitely been discovered. Even before the Sholomitsky findings, Dr. Kardashev had been interested in the possibility of intelligent signals from CTA-102 (see *Science Digest*, Feb. '65). All radio astronomers admit that the emissions from this radio source are unique, and late last year Dr. Kardashev suggested that they might be artificially produced.

But it is a long step from saying that radio emissions might be artificially produced to saying a supercivilization has been discovered in space. At the news conference, Dr. Kardashev would not confirm he had taken this step. All he said was, "I want them to be from another civilization." But he admitted that the argument in favor of an artificial origin was "merely a hypothesis, though a very fruitful and interesting one." Most astronomers think the signals have a natural origin.

Prof. Dimitri Y. Martinev, director of the Sternberg Institute, said the work of his scientists "has not been correctly interpreted." Prof. Iosif S. Shklovsky, chief of the Department of Radio Astronomy at Sternberg, went further. Although he said scientists could not tell Tass what to publish, he added:

"It is our right to ask journalists that they respect their great responsibilities, which does not always happen."

This type of open criticism of the official press agency is almost unheard of in Russia.

But the blame could not be laid entirely on the press. The astronomers had broken scientific protocol by publicizing their findings before first publishing them in a learned scientific journal.

Several years ago, Prof. Shklov-

Westerners tend to think of Russians as a dour, unimaginative people, who do not engage in speculation or the creation of wild science stories.

sky himself was the source of a well-publicized wild story. He said one of the moons of Mars had some of the characteristics of an artificial satellite. Soon the world was astonished to learn that Martians had "orbited satellites" (see page 45).

Tunguska Catastrophe

Still another bit of Soviet speculation treated as fact, which still crops up in discussions of extraterrestrial life, is the idea that a gigantic spaceship exploded in Siberia June 30, 1908. In 1908, there *was* a huge, unexplained explosion known as the Tunguska Catastrophe, which occurred in the Central Siberian uplands 400 miles south of the Arctic Circle.

In 1960, geophysicist A. V. Zolotov studied the site and was unable to ascertain any known cause for the catastrophe. However, some of the evidence he discovered might be interpreted as indicating that the cause of the explosion was a huge nuclear-powered spaceship. But Zolotov himself cautioned, "No matter how attractive it might be now to conclude that a spaceship from another planet exploded over the Tunguska taiga, a natural caution makes us refrain from doing so. In spite of the great advances in our knowledge of the structure of matter, we are far from knowing all about the internal 'deep' properties of matter, about the conditions under which nuclear energy can be released. We do not know but what on June 30, 1908, the earth collided with some very extraordinary, still unfamiliar but natural heavenly body."

His council of caution has been largely ignored.

Russia has no more scientific speculation, fraud or error, than any other advanced country. Why is it that wild stories that come from there get so much more attention?

One reason probably is that all stories are released through the official news agency, and no matter how inaccurate they are, they sound as though they have the backing of the entire Soviet government and scientific establishment. Until Shklovsky's denunciation, there has been little public criticism of how Tass has handled its science reporting job.

A second reason might be that Westerners tend to think of Russians as a dour, unimaginative people, who do not engage in speculation. Couple this with the exaggerated respect many have had for Soviet science since Sputnik, and you come up with an outlook that will accept anything attributed to a Soviet scientist as proven fact.

Perhaps after this latest sensation, the world will be more wary.

Disaster from overcrowding

Studies show that among some animals a population explosion can have horrifying results. Does overcrowded man face the same bleak future?

by Bruce H. Frisch

THE population explosion could fizzle out in climbing infant mortality, sexual perversion, cannibalism and zombieism, if people are like Norway rats. Or it could end in a crash, if people are more like lemmings.

These are two ways animals react to overcrowding. A few scientists cautiously suggest humans may do the same.

As they probe the many cruel ways animal's numbers are limited, the scientists are finding that rising population density can trigger a strange new pattern of behavior and hormone changes. Their observations are forcing them to abandon the old formula of famine-disease-predators.

Animals like the lion and eagle have no enemies, they remind us, but do not cover the earth. Even among the animals who do have backboned enemies, ecologist Peter W. Frank points out, many scientists believe predators have little effect on death, because most of those caught would have soon dropped dead of something else. Disease is related to other factors, an important one is overcrowding.

And if food supply limited the animal population, says Frank, "the amount of vegetation characteristic of the earth would not exist." Nevertheless, "Density has a marked effect on reproduction in all species that have been studied in the laboratory."

How this works with birds in the wild has been studied by V. C. Wynne-Edwards, professor of natural history at the U. of Aberdeen, Scotland, who concluded that the birds limit themselves. Among many land birds, each male stakes out an area for himself containing

When the lemming population crash came, it wasn't by the fabled mass suicidal swim to sea; they died in their burrows surrounded by plenty.

more than enough food and room for breeding. Birds at the bottom of the pecking order are simply squeezed out of the feeding ground.

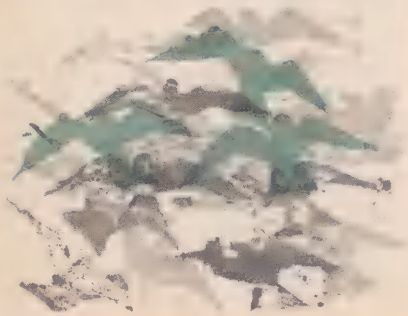
At sea, where birds cannot allot territory in the feeding ground, they set up a scale model on shore by contending for a nesting space in the rookery. The size of the rookery is kept limited, and the birds that are pushed out are not allowed to nest elsewhere.

Usually no one gets hurt in the struggle for territory. The "fights" are symbolic plumage displays, or singing or threatening contests.

Where there is no territorial system, Wynne-Edwards believes, animals may keep track of their numbers by mass flights or dawn or dusk choruses. Fireflies may take count by flashing their lights.

How pretty compared to the ways of the Norway rat.

John B. Calhoun, a research psychologist with the National Institute of Mental Health, housed a colony of 80 rats in a four-section pen made for 48. The two toughest males soon took over the two end sections for the exclusive use of themselves and their harems, squeezing everyone else into the center sections.



Under these conditions, the rats developed a need for company while eating or drinking. As a result, most of those in the center jammed into one section, making the crowding even worse.

Some males sought escape by complete withdrawal. No sex, no fighting for top spot. They crept out to feed only when the rest were asleep. They ignored others and were ignored in turn.

A second group of males became overactive sexually, but wouldn't fight. They pursued males and the young and harried females (in heat or out) right into their burrows in violation of courting custom.

A third, relatively normal group of males in the center sections grew scarred from constant battles for dominance.

Gradually, under the hounding by overactive males and from the distractions of the crowded quarters, the females began ignoring their pups. They stopped building nests, misplaced their young, and fed them fitfully. Among some groups, infant mortality rose to 96 percent. While probing the bur-

rows, overactive males found the bodies and took to cannibalism.

Among other animals, the pressures of overcrowding seem to bring about destructive changes in body chemistry. Lemmings may be an example.

In 1960-61, the lemmings in Norway hit a peak in one of their violent population swings. Imperceptibly, except when they piled up at water obstacles, they spread down the mountains. Over from Stockholm, Sweden, to watch came Kai Curry-Lindahl of the Nordiska Museet and Sansen. As the numbers of lemmings swelled, he saw them get caught up in a "kind of psychosis, possibly owing to the competition with other individuals for sheltering holes and territory," which set off mass rushing, jostling and screaming. When the population crash came, it wasn't by the fabled mass suicidal swim to sea, or by starvation; the lemmings died in their burrows surrounded by plenty.

A clue to this mysterious wave of deaths may come from the experiments of W. B. Quay, at the U. of California, in which he put lemmings through abnormally high temperatures and stress. The brain damage he found, says Quay, "is probably only a preliminary phase to the physiological collapse that precedes the breakdown of adrenal function, which in turn causes the death of large numbers of lemmings and explains the sudden crash of the whole population."

Lions as well as lemmings can

suffer from overcrowding, it was discovered at the Philadelphia Zoo. In 1955, the zoo was short of animals and there were almost no deaths by heart attack. But as the zoo added to its collections, the rate of deaths by heart attack rose to 20 percent by 1961. Herbert L. Ratcliffe from the nearby U. of Pennsylvania Medical School believes that the heart attacks resulted from hormone secretions stimulated by the psychological strains of crowding.

Feedback mechanisms

After leading a study group at the zoo for over a decade, John J. Christian of the Albert Einstein Medical Center in Philadelphia thinks that similar mechanisms are at work in many mammals. With David E. Davis, professor of zoology, Pennsylvania State U., he believes in "the existence of endocrine feedback mechanisms which can regulate and limit population growth in response to increases in overall 'social pressure,' and which in turn are a function of increased

Unless we curtail the population explosion, overcrowding will turn over control to "group selection," which in human terms means war.

numbers and aggressive behavior."

With the same theory, Christian and Davis dispose of disease as a controller of population. They contend that hormones secreted as a result of overcrowding lower resistance. "Thus, disease is a consequence of high population rather than a primary cause of a decline in population."

Animal and human populations

Christian cites experience with many animals such as woodchucks, deer and snowshoe hares, and finally ventures that "although our experiments have been with animals, we believe the same mechanisms, with certain variations, of course, might be at work in human populations."

He gets some carefully worded support from Hudson Hoagland, executive director of the Worcester (Mass.) Foundation for Experimental Biology. There isn't enough information, warns Hoagland, to say definitely, but humans may react like other animals to the stress of overcrowding since the human pituitary adrenal system "responds under stress in a way similar to that of other animals."

According to figures on the population explosion, we would seem to be on the way to testing this theory from practical experience. World population is now over 3.283 billion. The United Nations "high projection" calls for about 6 billion by 2000.

Up to the time the Pilgrims landed on Plymouth Rock in 1620, the world had been doubling its population about every 10,000 years. The next doubling took only 200 years, and the next, 90 years. Today's doubling time is 35-40 years and is still dropping.

Until recently, the West led population growth, because better public health practices and a rising standard of living cut the death rate while the birth rate remained unchanged.

On top of this, the rise of cities pyramided the trend toward crowding. Until the Industrial Revolution the largest cities had about 1,000,000 people spread over wide, undifferentiated areas. In the late eighteenth century, the steam engine supplied power for factories and for the railroads that distributed their products. Factories drew concentrated masses of workers around them in denser, larger manufacturing cities.

Urbanization is still going on, and New York City is probably its most extreme result. The metropolitan area holds over 16 million people, and at its center is jam-packed Manhattan Island with about 1,650,000 people living in 22.6 square

miles for a density of 73,000 persons per square mile. In residential areas, the density reaches 380,000 persons per square mile, giving each person 75 square feet, just about enough to park his car.

On the other hand, Manhattan had a population over 40 percent larger in 1910. In 1886, the electric street car started deconcentrating cities. The motor bus did it even better, because its routes could be readily changed. The truck did its part by allowing factories to leave the railroad lines. Today, while metropolitan areas are growing faster than the national population, central cities are often actually losing population. The suburbs are doing all the growing and the rural fringes of them are growing fastest of all.

2,000,000 work in Manhattan

But as the dwelling density in the central city was going down, the working force density was once more going up. When the telephone and Teletype arrived, management found it no longer had to stay at the factory; in fact it was an advantage to move itself and its office workers to a commercial center. In New York, where all who wanted to come couldn't fit, skyscrapers were raised. During the day nearly 2,000,000 workers now crowd into midtown Manhattan.

Urban sociologists think a decentralization of central offices is overdue. And so the new crush may pass. It's a case of one trend cancelling another, illustrating how difficult it is to predict where and when the disaster of overcrowding could some day strike.

It's not clear whether we unconsciously know if and when there are too many of us. When the standard of living had risen enough in the West, the birthrate fell off. In industrialized society, people began to see that it was to their benefit to have fewer children. They wanted other things instead, or wanted to give fewer children a better education, for instance. The decline started in the cities and continued to be lower there, until in some times and some places cities were no longer replacing themselves.

Is this endocrine feedback? Probably not. Scientists emphasize how calculated decision is required by the individual, and use it as an example of the sensitivity of man to cultural pressure which will make drawing parallels between humans and animals especially tricky.

To Scotland's Wynne-Edwards these statistics obviously mean that feedback is not working in man. It did once, he believes, and was expressed "in three ritual practices—infanticide, abortion, and abstention from intercourse," but the old customs and taboos faded when men turned farmers. Unless we set limits on ourselves, says Wynne-Edwards, overcrowding will turn over control to "group selection," a term borrowed from the animal kingdom, which in human terms means, in one way or another, war.

Scientists are proposing fantastic plans to guard against... THE DAY WE RUN OUT OF WATER

Wide World

Only a trickle of water recently flowed under bridge that spans the Boonton Reservoir in Northern New Jersey.

by James E. Bylin

SOMETIME early in the next century the U.S. could be using every drop of fresh water available. A parching thirst would then overtake the land.

It would come slowly, year-by-year, as population growth forced an ever-smaller ration of water to each person. Swimming pools, green lawns and similar luxuries would be the first to disappear; eventually, industry and agriculture would be undermined by the water famine.

Such a calamity is not far-fetched, though admittedly it makes the pessimistic assumption that no sizable new sources of water will be found. Pessimistic or not, many experts are concerned. "Water problems could be a distinct limiting factor in the U.S.," says Richard Highsmith, chairman of the department of natural resources at Oregon State University.

The great hope is that water scarcity can be averted by technological advances, some of which are in sight, though not yet entirely certain. Chief among them would be a way to cheaply remove salt from sea water, which makes up 97 percent of the earth's water supply. Other equally ambitious proposals, plus measures to conserve and

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purify present water supplies, offer promise, too. Already, billions of dollars yearly are being mobilized to attack the nation's water problems. Many more billions, much of it in taxpayers' money, will be spent in the next few decades.

Schemes advanced

One measure of the seriousness of the problem is the far-out schemes seriously advanced by scientists to augment water supplies. A U.S. Senate report discusses covering thousands of square miles of Arctic wasteland with carbon black to absorb the sun's rays and melt ice into water that could be trapped in storage basins. George Kennedy, a UCLA scientist, proposes that a five-megaton nuclear blast could create a huge chamber two miles underground into which sea water could be pumped; torrid temperatures of 350° Centigrade would shoot the water back to the surface as steam, to be condensed into potable water after it drives electrical turbines.

At first glance it would seem that the U.S. has ample fresh water. Each day an average of 4,400 billion gallons in the form of rain or snow fall on the continental U.S. Of this total, about 1,100 billion gallons enter the nation's streams, lakes and underground reservoirs to become potentially usable; the rest returns to the atmosphere or is absorbed by plants. From this huge supply, the U.S. presently consumes 350 billion gallons a day.

But even though we are using only one-third of the available water, national scarcity is in sight. By 1980, usage is expected to soar to 560 billion gallons a day and to 880 billion gallons by the year 2000. A few more years would bring the nation to the limits of its daily available supply, assuming every drop can be recovered.

Despite its enormous water problems, the U.S. is relatively a water-rich nation. Water shortages, notes President Johnson, are "even more acute in many arid developing countries where future economic growth is absolutely dependent upon finding new sources of fresh water."

To a remarkable extent the standard of living depends upon abundant, clean water. Each U.S. household uses 16,000 gallons a month. But domestic use, though huge, is only 8 percent of total demand. The nearly insatiable consumers of water are agriculture and industry. It takes 1,600,000 gallons to irrigate an acre of farm land for one growing season; for each person in the U.S., farmers draw 500 gallons a day from streams and wells to irrigate crops. Industry uses 170 gallons a day per person; it takes five barrels of water to refine one gallon of crude oil, 700 gallons to process a ton of oranges into juice, and 13 gallons to brew one gallon of beer.

Even the present water supply, seemingly enough for the next few decades, conceals severe regional shortages. It is precisely the arid

A study by the U.S. Public Health Service's division of water supply and pollution control reported 6.3 million fish killed in 7 months.

Southwest—Arizona, Southern California, New Mexico and Nevada—which is growing fastest and demanding more water. Some 1,000 miles separate the sparsely settled Wynoochee Oxbow region of northwestern Washington and Los Angeles with its teeming millions. But the water differential is even greater. The Washington area, the wettest spot in the continental U.S., gets 150 inches of rain a year; Los Angeles receives less than 15 inches.

Regional water shortages increasingly are bringing stiff curbs on water usage in many communities. This spring, residents of New York City were told they could water lawns with hoses only during a six-hour period each week and they were ordered not to fill backyard wading pools. Because of a 44-month drought in the Northeast, the city's reservoirs held only 40.4 percent of capacity.

Even as such fresh water shortages plague some regions, other headlines spotlight serious problems of wasteful oversupply, such as spring floods in the Midwest and flooding in Northern California. In one week in California, rampaging rivers disgorged more water into the Pacific Ocean than could be carried in three years by the state's mammoth 740-mile, $2.2 billion North-South water project now under construction.

In much of the East and the Midwest, where generally abundant water coincides with big urban areas and industrial concentrations, it is pollution that is the burgeoning problem. New York's Gov. Rockefeller said that nearly two-thirds of the state's population live in areas affected by water pollution. Pointing out that 2,100 pollution sources have been identified, including 1,167 communities that are pouring sewage into waterways, the governor proposed a $1.7 billion clean-up program.

Water pollution

Pollution hardly is confined to New York State. A study by the U.S. Public Health Service's division of water supply and pollution control reported 6.3 million fish killed by pollution in 36 states during a seven-month period. Industrial wastes, blamed for 5.5 million fish deaths, were considered the main killer.

Government and industry together are mounting a varied attack against the many-faceted water problem. On one front they are trying to make the present supply of water serve man better, moving it from areas of surplus to areas of scarcity and keeping it as clean as possible. In another sector they seek to increase the total fresh

water supply by desalination, stopping evaporation and seeding clouds to increase rainfall.

Water problems expensive

The attack on water problems is expensive and promises to become more so. In an exhaustive study made in 1960-61, the U.S. Senate's Select Committee on National Water Resources estimated that $228 billion, including $54 billion in Federal funds, would have to be spent developing water resources by 1980. This staggering figure is far more than the total present investment in water facilities, calculated at $179 billion in 1958.

As the problem mounts, more responsibility is being shifted to Uncle Sam, although cities, states, utilities and other private industry still shoulder the major share of the $10 billion spent each year on water development. No less than 40-odd Federal departments, agencies and commissions deal with water. For fiscal 1966 President Johnson is asking Congress to appropriate $1.9 billion for water resources development and research, up from $1.2 billion in 1960.

One new Federal office is the Interior Department's Water Resources Research Department, created last year. The new agency recently allotted $75,000 apiece to 14 universities to tackle study projects as a first step toward a national plan on water research. The projects will cover not only water usage and quality, but also legal and administrative water questions and even the psychological problems of convincing people to drink reclaimed waste water.

But money spent on pollution would be peanuts compared with the cost of some proposals to move water from one area to another. The most ambitious advanced thus far comes from Ralph M. Parsons Co., an engineering and construction firm based in Los Angeles. Called the North American Water and Power Alliance, it is a thirty-year scheme with a huge $100 billion price tag. It would move Alaskan, Canadian and Pacific Northwest waters to areas as far east as the Great Lakes and as far south as the Mexican state of Baja California, meeting projected water demands for a century. A series of tunnels, canals, locks, reservoirs, siphons and pumps would move the water over the Canadian Rockies into the U.S. and Northern Mexico. In essence, rivers now running unused from the Rockies into the Pacific would be diverted to the water-scarce areas.

The company figures its plan would provide irrigation water for more than 50 million acres and double the electric power generating capacity of the U.S. The system could be maintained and the original investment paid off in 50 years, Parsons claims. One by-product would be a canal system, capable of handling ocean-going ships, that would connect the St. Lawrence Seaway to the Pacific Ocean.

There's no question that more

The desalter of the future will undoubtedly be dual purpose, combining sea water conversion with the atomic generation of electric power.

modest regional plans have run into opposition. When Interior Secretary Udall unveiled his Pacific Southwest water plan in 1963, he was bombarded with protests. The plan called for further development of the Colorado River and envisioned tapping Northern California rivers to meet Arizona's needs. The cost: $4 billion.

The Udall proposal grew out of the U.S. Supreme Court's decision to give Arizona a sizable portion of Colorado River water now being siphoned into Southern California. A unique aspect of Udall's plan was that it embraced both the inter-basin and the interstate movement of water. In the past, the largest Federal projects have been limited to a single river basin, although several states may be affected. Seven states, for instance, are fed by Colorado River projects and four states share in Columbia River power projects.

Today, the need for inter-basin regional planning is pretty well accepted by leaders in the Western states, at least in theory. But traditional sectionalism persists and a long struggle lies ahead to determine which regions have water surpluses, to persuade these areas to release supplies to aid water-poor regions and to decide how the states and Federal Government will divide control and financing.

Meanwhile, water experts cherish the idea that desalting sea water will help solve many problems. Says William E. Warne, director of the California Department of Water Resources: "I firmly expect atomic power and sea water desalination to become building blocks in . . . our great water projects in the immediate future."

Desalination program

President Johnson last year ordered an expanded desalination program, asserting, "Within the next decade desalted water will be the cheapest—and in some cases the only—way to obtain new water supplies in many areas." Under a crash program, the Office of Saline Water of the Interior Department hopes to spend some $30 million a year on sea water conversion research over the next seven years, compared with $12 million in its current budget.

A key problem is to reduce the cost of salt water conversion, which now stands at roughly $1 per 1,000 gallons. By contrast, the average household bill for water, excluding pumping, distribution and storage charges, is about 10 to 12 cents per 1,000 gallons. But engineers are confident they can reduce further the cost of desalination. Today's $1 cost is far from the $4 per 1,000

gallons which was estimated in 1952.

The desalter of the future, as visualized in one now being planned for the Metropolitan Water District of Southern California, undoubtedly will be dual purpose, combining sea water conversion with atomic generation of electricity. This project, which could cost $200 million or more, would serve the Los Angeles area; if the water district goes ahead with the plan after engineering studies are concluded, completion tentatively is scheduled for 1970. It would turn out 50 million to 150 million gallons of fresh water a day. The maximum output would supply a city of 750,000 people. Even at minimum capacity, output would equal the total amount of water now desalted throughout the world.

Other water projects

However, California's Warne cautions that desalting will provide only an important supplemental or emergency water supply. It won't negate the need for other water projects, he says.

Along with desalination, efforts to halt evaporation and seepage may help extend water supplies. Each year seven feet of water evaporate from huge Lake Mead behind Hoover Dam on the Colorado River. In some areas it is figured that two-thirds of irrigation water never reaches the crops; the water simply disappears into the air or ground. Researchers are struggling to come up with cheap methods to line irrigation ditches with concrete and to develop sprays that would blanket reservoirs with a protective covering only one molecule thick to halt evaporation.

Two scientists from Columbia University and the University of California at Berkeley recently reported that one-molecule chemical layers used in Australia stopped evaporation at a cost of only two to five cents per 1,000 gallons saved. American research shows a cost of 10 to 12 cents per 1,000 gallons, they said, noting this is far below present or projected costs to desalt sea water.

Along rivers and around lakes, small plants called phreatophytes grow in profusion. These are useless "water-stealing" plants that cover 15 million acres of Western land and consume more than 25 million acre feet of water each year. Researchers are trying to develop poisons to stymie the phreatophytes; they say the West's irrigation problems could be improved if the plants were replaced with beneficial foliage such as crop grass.

Researchers also are working on ways to control or modify the weather; but they glumly agree that, barring some unforeseen breakthrough, large-scale weather control remains far in the future. Despite the fact that rainmaking through seeding of clouds with chemicals, has been done successfully since 1946, the results have been modest and the technique as yet doesn't fit into solutions now being devised by most water planners.

Death isn't necessary

by Dr. Arthur W. Galston

I BELIEVE it no exaggeration to say that biology is the most revolutionary of all the sciences today.

We are on the threshold of achieving a basic understanding of certain aspects of the living state which will completely change our way of life, in the same way that the physicists' new knowledge of the nature of the universe has already revolutionized our way of living, our technologies, and our concepts of the problems before us. . . .

Is it necessarily so that all creatures must die? We know that the ages at death of different biological systems vary tremendously. Individual cells of some microorganisms live only several hours; with other creatures it is only a matter of days or weeks. Many creatures live for one year, dogs for several years, man for 70 or more, and the oldest trees on earth for approximately 3,000 years.

In all instances, the death of the individual is partially circumvented by a trick, a trick of packaging up in specialized reproductive cells of sufficient substance and protection to insure that the chromosome complement will be able to reproduce itself at some time. Plants may do this by seeds and spores, animals do it by reproductive cells of other types.

Now, why is it that microbial, animal, or plant life dies at all? Is death a necessary consequence of

Condensed from a speech delivered at the Yale Alumni Association of Northern California.

life? The answer delivered in the last generation or so by biologists is a resounding No.

You will permit me if I, as a botanist, use a plant as an example at this point. Most plants go along vegetating for many months, producing roots, stems and leaves, and would do this indefinitely were it not that the environment, usually through the length of day, gives them the signal to start going into reproduction. At this point they produce flowers and, after the normal sexual process, fruits.

When fruits start to develop on the plant, the entire physiology changes. Vegetative vigor usually declines, and as more and more of the nutrients of the plant are channeled into the fruit, death of the vegetative organs ensues. The vegetative plant finally dies, a sacrifice to the continuation of the species in the form of the seeds within the fruit.

If the sex organs of the flower are systematically prevented from developing in the plants, the plant may continue to persist indefinitely. Such sexless plants may be grown in a greenhouse for many years, while their normal brothers and sisters will have passed on at the end of the first year of normal flowering and fruiting.

There is an even better trick which can be played by biologists, a trick which involves cutting little pieces of an organism off the creature and transferring it to a test tube or other container, where it can be furnished with all the nutrients required for successful, happy growth. This technique is frequently referred to as tissue culture. Cells removed from any multicellular creature and cultivated in this way, on chemically defined media, behave like a population of bacterial cells; that is, they go on growing as long as the nutrient is kept fresh.

Immortal cells

Therefore, as long as intelligent and skillful men prepare fresh bottles of nutrient and transfer cells from one bottle to the other indefinitely, the creature so cultured need in fact never die. This experiment has been conducted very successfully with tissue derived from the carrot plant.

As you know, the carrot is a biennial; during the first year it produces a little rosette of leaves and the fleshy storage root which we harvest and eat. During the second year, the reserves of food are channeled into the production of a huge seed stalk, the familiar "Queen Anne's Lace" of the field. Here the plant consummates the sexual act and produces the seeds which carry on the species. At this point, however, the parent plant dies.

In 1937, a French tissue culturist removed a group of cells from the inside of a carrot root and placed them on a nutrient medium. He then transferred the cells periodically to a new medium. This carrot, now 27 years old, is still alive and

Since 1900, we have been living in an era of increasing biological revolution, climaxed by the recent revolution in molecular biology.

growing happily, and so far as we know will continue to do so without any interference as long as proper procedures are followed.

What do these cells look like? Are they actually carrots growing in a test tube? No, not at all, they constitute an undifferentiated tissue mass which the biologist describes as a callus—that is, a group of undifferentiated, fluffy looking cells which do not obviously carry the characteristics of the organism from which they are derived.

Under proper manipulation, however, a single cell of such a callus may be caused to give rise to a group of cells which will then produce organized roots, stems, leaves, flowers and fruits. This monumental achievement, realized only within the last decade, tells us that probably every cell of the organism contains within it all of the basic information needed to produce the entire creature. Thousands and thousands of carrot plants may thus be produced from one or few cells deep in the interior of one carrot root.

The technique of tissue culture has also been applied successfully to animal cells. Organs and even individual cells may be extirpated from various parts of the creature and caused to grow in Petri dishes as thin layers. Human cells are no exception to this generalization. Any one of us could walk into a tissue-culture laboratory, donate cells of skin, of liver, of kidney, of muscle, and of other organs, which could then be grown successfully in complex nutrient media by tissue culturists. If the tissue culturists were skillful enough, and we know that they are, the cells we donate, like the cells of the carrot, could grow potentially indefinitely.

Here is man's dream of experimental immortality, and the path to immortality is now clear. All you have to do is to make yourself $1,000,000 or so . . . and then endow a laboratory for the perpetual cultivation of your own cells. In the form of thin layers of tissue in Petri dishes, you could persist triumphantly through the ages.

But would you know then that you persisted? Would those layers of undifferentiated muscles, skin, liver, and other cells really be you? Would you in that form have a mentality? Alas, these questions are premature. We cannot in fact yet reconstitute man from a single cell cultured in a monolayer in a Petri dish. But just as we have recently been able to reproduce a carrot plant from a single cell, isolated from a mature organism, so—I

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believe—we shall one day understand the problems involved in doing the same job for man. Then from each of us could be taken cells to be cultured in appropriate media to make as many copies of ourselves as we would like. Truly, this is a staggering prospect for a world already reeling from the prospects of over-population arrived at through more conventional reproductive methods.

But there is even further that we can go, following the directions offered to us by the new biology. One hundred years ago Gregor Mendel, an obscure monk working on pea plants, discovered the basic laws of genetics.

Molecular biology

Since 1900 we have been living in an era of increasing biological revolution, culminated in the last two decades by the birth of the vigorous science of molecular biology. Thanks to the incisive investigation of a mere handful of biological geniuses, we know now that the essential genetics material of which we are all made is a single chemical substance, deoxyribonucleic acid (a DNA). Basically, we may think of this substance as a long string of beads in which there are only four types of beads, equivalent to the four complex units strung together in the DNA molecule.

If we give these beads the names a, b, c, d, then in fact the basic message is spelled out by a, b, c, d, a, b, c, d, a ,b, c, d or a, b, b, c, c, d,

Dr. Arthur W. Galston

d, a, b, b, c, c, d, d, or some other variant thereof. All of us may then be represented as a kind of an IBM ticker-tape in which our characteristics are spelled out in a four-letter alphabet.

How does this alphabet become translated into the creatures that all of us are? We now know that the DNA code is translated ultimately into another code, the amino acids of the protein. Since there are roughly 20 amino acids that constitute the proteins out of which we are made, the cell must face the complex problem of transcribing the information obtained in the 4-letter alphabet into a 20-letter alphabet. The way this is done appears to be the following. A group of three of the units of DNA is first translated into another group of three sequential units of a closely related molecule named RNA also found in the nucleus. The RNA then passes into the cells, and there again the triplet units code the order in which the amino acids, 20 in nature, will be assembled into the proteins.

Huxley's Alpha plusses, the intellectuals, and epsilon minuses, the slaves, could be produced at will by a variation of the nutrient medium.

Since all of us are mainly protein, and since it is the protein of which we are made that determines what we are, the sequence of translations and transcriptions from DNA to RNA to protein represents the orderly elucidation of the entire creature from a simple cryptic code. We are what we are by virtue of the genes we contain in our chromosomes. These genes are DNA and they act to elicit their message by controlling, through the intervention of appropriate RNA, the proteins of which we are made. The control of the nature of the organism, therefore, lies in the control of the DNA of each cell. During orderly reproduction, the DNA of each cell is exactly partitioned and given in equal lots to the daughter cells resulting from the division. This fact now gives man an opportunity for further control of this process.

About 20 years ago, Dr. Oswald T. Avery and co-workers at the Rockefeller Institute discovered that one type of pneumonia-producing organism could be changed into a second type in a very simple manner. The process involved merely the extraction of certain chemicals from Type 1 which could then be placed into the medium in which cells of Type 2 were growing. Cells of Type 2 apparently took up and incorporated into themselves this chemical, which then became part of their own genetic material.

By now you should be able to anticipate that the active material extracted from cells of Type 1 by Avery and transferred into cells of Type 2 resulting in permanent genetic alteration was in fact DNA. This phenomenon is called transformation; it represents a complete bypass of the normal sexual reproductive method; it is in fact a way of combining the DNA of two creatures without any sexual fusion.

Genetic revolution

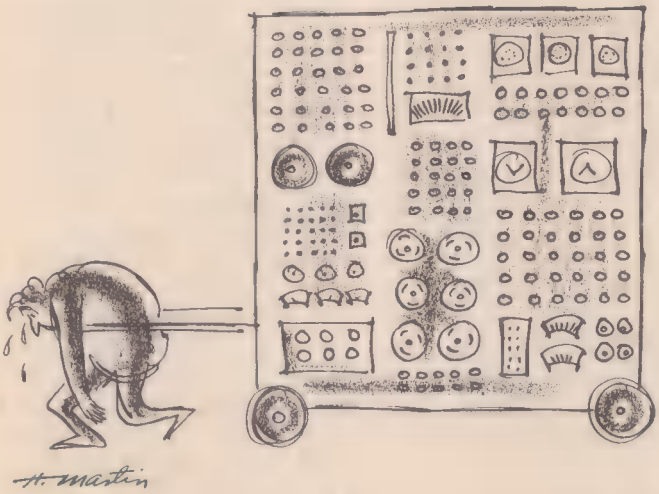
Think for a moment of the implication of this finding. If in fact we can take single cells of a genetic type, place them in the medium in which they are growing—DNA from other cells that will then enter and transform the cells we are culturing—we have indeed a powerful tool for speeding up genetic change and evolution. So far the phenomenon of transformation has been accomplished only with bacterial cells, but at the rate at which biological progress is now occurring, I would expect to see transformation accomplished within my own lifetime with much more complex creatures.

Not long ago, for example, Joshua Lederberg discovered that in some instances the transformation

process could be carried out by using a virus to introduce foreign genetic material into a host cell. This phenomenon, called transduction, is also at present limited to microorganisms. But by one means or the other, man is going to learn how to sneak foreign DNA messages into any cell and fool it into thinking that the foreign DNA is part of the cell's own genetic complement.

See now what a tool this puts into the hands of man. If he is able to culture his own self as single-celled organisms in a Petri dish; if he is able to introduce foreign DNA into these cells, causing genetic transformation, he is really at the threshold of Aldous Huxley's *Brave New World*. Alpha plusses, the intellectuals, and epsilon minuses, the hewers of wood and drawers of water, could be produced at will by simple variation of the nutrient medium in which tissue-cultured men would be developed.

Whether one likes this picture or not, it is no longer to be considered in the realm of science fiction. It is within man's capability to bring this about within our lifetime. We may yet see the day when famous men, such as Einstein, will donate to a laboratory some tissue from which DNA will be extracted and placed into a nutrient medium. The cells of other receptors, man or woman, steeped in this fluid in a particular way would pick up the Einstein DNA which could then become part of just anybody's genetic make-up. What a way to change the nature of man!



SCIENCE ABC's

Wind—the air in motion

KFS

A WIND is simply air in motion. If you blow up a toy balloon, so that the air inside it is under pressure, and then let go of the nozzle, the pressure at once drives the air out again and you can feel it as a wind. The air comes out because there is less air pressure outside the balloon than inside, and it is a general rule that winds always blow from high-pressure areas to low-pressure areas.

Now, the atmosphere which covers the earth is liable to great variations in pressure, owing to the fact that some places are warmer than others. Air contracts when it is cooled, so that cold air is packed more tightly together than warm air—it is at a higher pressure. Warm air, on the other hand, expands and because it occupies more space it is thinner than cold air—it is at lower pressure. Because it is thinner it is also lighter, and tends to rise like the hot smoke over a bonfire. In places where the air is simply rising or falling no winds are felt, and these are regions of calms; wind is only felt when the air blows horizontally.

The earth is warmest near the equator, so that it is encircled by a belt of warm, rising air. Here, then, is a belt of low-pressure calms, old time sailors called it the "doldrums." When they got becalmed in the doldrums they were likely to die of starvation or thirst unless a storm arose and blew them out again. As the air rises over the doldrums, the cooler air north and south of the equator, being at higher pressure, blows in to take its place. But because the earth is spinning around, these winds do not blow from the north and south, but from the northeast and southeast. These are the trade winds.

Because of the doldrums it is very difficult to sail across the equator, except at certain seasons of the year. In July, the sun moves slightly north of the equator and the southeast winds then blow across it. In December, the sun is south of the equator and the northeast winds blow across it. The old sailors took advantage of these

changes to carry them across the equator to trade in the southern hemisphere. This is how they became known as the "trade winds."

Now let us follow the air that was rising over the doldrums. By the time it reaches a height of three or four miles it has cooled and does not rise any higher. But more air is coming up behind it, so it spreads out and blows back towards the north and south, travelling in the opposite direction to the trade winds but at a great height above them. These winds are called the "anti-trades," though they are never felt except on the tops of high mountains, as in the Canary Islands. They get colder, denser and heavier, and finally descend to earth again at about latitudes 30° N. and S. of the equator. Just as it was calm in the doldrums where the air was merely rising, so it is calm again at 30° N. and S., where the air is merely coming down, and the sailors called these high-pressure calms the "horse latitudes." This was because they frequently shipped horses from Africa to America, and if they were becalmed in mid-Atlantic they began killing and eating their cargo as soon as their food ran short.

When the descending cold air reaches the ground, it spreads once more to the north and south, part blowing towards the equator and part towards the poles. The part blowing towards the equator we have already met with as the trade winds. The part blowing towards the poles is known as the "westerly variables." These winds start off as southwest winds, owing to the rotation of the earth, but they become more and more westerly the farther they go. Eventually they blow round and round the Arctic and Antarctic Circles. At latitude 40° S. they were known to the old sailors as the "Roaring Forties" or "brave west winds."

Over the North and South Poles, where the air is exceedingly cold, there are two high-pressure areas of "polar calms." The junction between these areas and the westerly variables blowing around them is known as the polar front. This completes the set of winds and calms known as the "planetary wind system," and its winds are sometimes called the "permanent winds." These winds are not always steady, but are liable to develop eddies and storms, especially along the polar front.

There is one other major class of winds. These are called "seasonal winds." In their summer times, the tropical regions of the large continents get very hot and the air over them rises. They then draw the trade winds in from the cooler oceans around them, often changing their directions entirely, and these winds are then called "wet monsoons." In their winter times the same regions become extremely cold, and the air above them, being now at high pressure, blows outwards towards the oceans, which are now warmer than the land. These winds are the "dry monsoons."

X-Rays—seeing inside solid substances

Ordinary visible light rays have a wave length ranging from a 25-thousandth of an inch to a 60-thousandth of an inch. X-rays are waves of the same kind, only they are from a hundred to a thousand times shorter. Our eyes are adapted for seeing light rays but not X-rays, which are quite invisible to us. Most substances, except heavy metals, are more or less transparent to X-rays, which pass through them as easily as light does through glass.

X-rays were discovered in 1895 by Wilhelm Röntgen, who found that they blackened photographic plates which were wrapped in paper and cardboard to protect them from light. X-rays pass easily through such substances as paper and wood, and through the skin and muscles of the human body. They pass less easily through bone, so that Röntgen was able to photograph the bones of his hand by simply laying it on a wrapped photographic plate and exposing it to X-rays. The flesh of his hand appeared in grey, and the bones came out as white areas. X-ray photographs of the body have since been widely used to show if bones are fractured or broken, and to locate objects such as pennies or nails that have been swallowed by children.

Doctors also use X-rays to examine the organs of the body. Just as you can see bubbles in glass with ordinary light, so X-ray photographs will reveal cavities and pockets of fluid, (such as abscesses) inside the body. If a salt of a heavy metal, such as barium sulphate, is mixed with a patient's food, the stomach and intestines can also be photographed and food-blockages detected. If it is unnecessary to prepare photographs for study, the X-rays can be made visible by means of a fluorescent screen. This is simply a sheet of glass coated with sulfate of quinine or some other substance that shines when X-rays strike it.

Very powerful X-rays will destroy the tissues of the body; but because they kill diseased tissues more rapidly than healthy ones, they are sometimes used to get rid of diseased tissues inside the body.

X-rays are used by scientists for finding out how the atoms are arranged in crystalline substances, and by engineers for locating bubbles, flaws and impurities in the various parts of machinery. Customs officers can use them to examine parcels without opening them, to see if they contain metal goods, such as watches, on which duty has to be paid. Art experts sometimes use X-rays to see if there are any inscriptions underneath the paint of a valuable picture.

KFS

Do you smell something?

by John and Molly Daugherty

NONE of us has developed fully the sense of smell that serves animal, insect and fish so marvelously. How much do you know about this under-developed sense?

1. Your sense of smell becomes dulled to the need for ventilation in a crowded room. How does this affect your awareness that a carelessly dropped cigarette is burning a hole in the wool carpet?
   a. The generalized fatigue of your sense of smell delays your awareness of burning wool.
   b. You become keenly and quickly aware of the wool-burning odor.
   c. The odor of burning wool is absorbed or masked by the multitude of odors in the room.

2. Which one of these odors has the lowest average threshold for you to be able to smell it?
   a. Rancid butter (butyric acid)
   b. Musk (perfume base—active ingredient muscone)
   c. Skunk (ethyl mercaptan)

3. To find your trail, a good tracking dog picks up your scent most easily from your:
   a. Feet
   b. Armpits
   c. Hands

4. The most effective place for perfume use is on:
   a. Your hair
   b. Your clothing
   c. The back of your ear

5. The female species of moth that gives off a specific scent, the analysis of which won a Nobel Prize for Adolph Butenandt in 1959, is:
   a. The Chinese silkworm moth
   b. The European gypsy moth
   c. The clothes moth

6. An odor is generally:
   a. A response of all the olfactory cells.
   b. A response of a single type of cell for that odor.
   c. A blending of a number of olfactory responses.

7. If you notice a faint smell of gas when you enter a room;
   a. Your first impression after a few quick sniffs is the most dependable.
   b. You'll be more certain of the presence of gas after five minutes.
   c. Charge it off to your imagination if you don't notice the gas after an hour.

8. Your olfactory membranes, located in the top of your nasal passages, are about the size of:
   a. A green pea
   b. A dime
   c. The head of a pin

9. In manufacturing fine perfume, oily substances, some of which come from animals, are used as a base. Which animal is in demand for perfume base?
   a. Antelope from Africa
   b. Okapi from Africa
   c. Deer from Tibet

10. If the concentration of the odor of a smelly substance is increased, it:
   a. Always increases the effect of that odor on your olfactory cells.
   b. May change the odor to a different one.
   c. Has little effect on the nature of the olfactory response.

Answers:

1—b You become quickly aware of a new odor even though your sense of smell becomes rapidly fatigued from constant exposure to the other odors in the room. The new odor introduced into the room is unaffected by the previous odors you have smelled.

2—b Musk. It has a much lower threshold value than either butyric acid or ethyl mercaptan. Approximately twelve thousand times as many molecules of skunk odor are required to reach your threshold of smell as molecules of musk odor.

3—a Your feet. A dog recognizes your scent from a complex pattern of chemical substances as peculiar to you alone as your fingerprints. Even if you've walked along a path the day before, a dog can track you because of the way your feet smell. The sweat in your feet works through your shoes onto the ground, unless your shoes are new or have rubber soles.

Each of your soles has up to 2,000,000 or more sweat glands from which 2 percent of your daily sweat is released. If only 1/1,000th of your sweat, a quarter of which is aliphatic, penetrates your shoes to your footprints, it's still over 1,000,000 times the threshold amount necessary for a good tracking dog to trace you.

4—c Back of your ear and your ear lobe. Here, the perfume is better protected from rapid evaporation. Your ear lobe is frequently moist, and the perfume lingers longer. Your clothing soaks up perfume, and evaporation is fast. Some of the compounds left on your clothing oxidize in the air at different rates. The last remnant of smell may not be pleasant. Perfume on your hair has greater exposure to air currents than that behind your ear. Consequently, it may not be so effective.

5—a The silkworm moth. Butenant used over 300,000 scent glands of female silkworm moths to attain eventually one small drop of pure oily scent material. This is so powerful that a 1,000,000th of a microgram (10^{-12} grams) diluted in one cubic centimeter of solvent will excite the male moth. Isolating the substance is the first step toward finding its structural formula.

About a year later, the U.S. Agricultural Service extracted a similar substance from the gypsy moth and synthesized the compound. The research is important in the attempts to control this pest.

6—c A blending of olfactory responses, according to the theory of components of smell. The organ of smell contains a great number of cells, but rarely even in simple chemical smells is only one type stimulated. The number of olfactory responses seems unlimited. It is probable that when you smell a new odor, a combination of smells that never before acted together in quite the same way is stimulated.

7—a Your first impression is the most dependable. A few quick sniffs draws air into the part of your nasal cavity where your sense of smell is located. Even within five minutes you begin to get accustomed to odors in the room, and after an hour you are unaware of the smell of gas.

8—b About the size of a dime. The pair of membranes is located high up in the nasal passage, protected somewhat from the main stream of flowing air. They are kept clean by a flow of mucous over the more than half-million specialized cells. Molecules of odorous substances must dissolve in the mucous to stimulate your smell mechanism.

9—c The male musk deer from Tibet. Musk from the scent glands of this deer is greatly diluted and used as a base for delicate fragrances. (There are some synthetic products now.) The base from musk has the special property of being long-lasting.

The civet, related to the cat family, is an African animal which also supplies a strong scent used by perfume manufacturers.

10—b Concentration may change the odor to a different one. The odor of many substances can vary depending upon their concentration. For example, the chemical ionone when very dilute smells like violets. In greater concentration, it smells like cedarwood. Apparently, different concentrations may stimulate a different combination of olfactory cells and alter the smell.

Score Yourself:

8—10 right—How did you smell out the right answers?

4— 7 right—Be more nosey so you'll learn more.

0— 3 right—Your score doesn't make any scents.

"I was flycasting near Loch Ness."

The Hugh Downs Column

All the fun is getting there

Hugh Downs has departed on a long-planned extended vacation during which he will sail to Tahiti aboard the 65-foot ketch Thane. *His column will not appear during his absence.*

As you read this I'll be in the early phases of a voyage under sail across the Pacific Ocean. There's some sort of appropriateness in my being occupied at that time with the very problems I want to speculate on in this article. Perhaps your collective attention will have a beneficial effect, not on the physical circumstances of my sailing, but on the emotional relation of those aboard my vessel to the fitness of the whole venture.

A friend of mine once referred to his little sloop as an "atomic" boat. When I smiled he assured me he was serious and explained that the engine he had weighed 2.18×10^{27} tons and radiated 70,000 horsepower per square yard of its surface. Being placed far enough outside his boat to avoid burning it, but near enough to provide power, it performed, he said, admirably, and in this manner:

First, by radiating heat constant-

ly it created a temperature differential on each side of the earth. Since the Earth rotated, this temperature differential did not stay at the same location, but moved, causing air on the side of the earth nearest the engine to heat, and rise, thereby creating a low pressure area into which cooler, denser air tended to rush. Advantage was taken of this movement of air by means of vanes called sails made of canvas or Dacron hoisted above the boat's decks. Since the air moved the vanes, it also moved the boat.

Atomic boat

In this sense every boat is powered atomically, for the energy in coal or petroleum products is solar (atomic) energy chemically stored in organic compounds and released through combustion. A sailboat is simply the most directly atomic powered of all boats including the nuclear fleet, since nuclear reactors must convert water to steam as a link in their power chain.

The first man to ride a floating tree trunk probably noticed that if the water was moving, he and his log were moved along with it. At some later stage he noticed that any part of the craft above the water level could be acted upon by the wind. Water is such a good bearing that the effect is noticeable with relatively little wind and even with very low freeboard. With negligible current and stiff breeze it must have been early apparent that the craft moved in the direction the wind was blowing.

With the discovery that hollowing out logs increased the capacity, the buoyancy, and the freeboard of a vessel, the boat was born and man became dimly aware that it was not a magic floating property of the material that made a boat buoyant but rather a matter of how much weight of water was displaced. Along about this time man must also have discovered that the wind effect could be greatly increased by fixing a lightweight material to an upright spar and thereby presenting a greater amount of boat area to the wind. The sail was thus born and might predate weaving since sails can be made of skins. In special circumstances where prevailing winds ran counter to currents (such as a river running in the opposite direction of a breeze) rowing and towing could be reduced to a bare minimum since boat and cargo could be blown upstream and could drift down on the current. If such were every sailing circumstance, sail would never have developed beyond the lateen rig.

The concept of being blown into the direction of the wind hung over into the 19th Century and is still used by square riggers whose square sails are most efficient when moving the boat in the direction the wind is blowing. This is called running and sailors spent centuries running before they developed tacking. Now the most curious aspect of sailing — and part of this still has an air of mystery in it — is

that the wind can be made to work against itself in effect by providing direct power that will propel a boat from one point to another directly against the wind. More than 50 centuries ago it was discovered that a boat being blown by the wind need not be forced to go in the exact direction the wind was blowing. With enough keel to prevent wide leeway and pressure on a rudder the boat might be sent in a direction somewhere near the direction of the wind but not exactly. With the gradual sophistication of hull design and rudder control it was found that wind could be made to impinge on sail areas in such a way that the boat would go at right angles to the wind. Up to this point of development, no boat could ever proceed against the wind but here enters the mystery of sailing. The same wind force that blows against the boat and sail can be made to slip off sheeted-in sail area in such a way that combined with rudder pressure the boat will translate the motion into a direction more toward the wind than away from it.

Zigzagging

This makes it possible through a process of zigzagging to move the boat ultimately directly against the wind. This zigzagging is called tacking and in it the wind is tricked into blowing an object toward itself instead of away.

Once the door is open to trick the wind in this way other tricks are possible such as "parking" the boat in open water in a breeze; although it is properly said to be hove-to, the boat is in effect parked. This is done by trimming in such a way that when the boat, with its helm fixed in a certain place, moves forward it tends to come up into the wind, that is it sails more and more on the wind until it gets into a position almost directly against the way the wind is blowing. At this point it will no longer sail and the wind tends to blow it in reverse but it is so trimmed that when it starts to move in reverse the bow falls off the wind, presenting more of the side of the boat to the wind, at which point it begins to sail again. When it begins to sail it repeats the cycle, moves into the wind, quits sailing, falls off again, begins sailing, moves into the wind, quits, etc. Barring current and a little lee slippage, a sailboat can be left in this parked position with very little change of location.

People who have spent a lifetime sailing are still baffled by some scientific aspects of it, and in the framework of some sets of dynamics a sailboat should not sail quite the way it actually does. But then when we reflect that according to the laws of aerodynamics the bumble bee cannot fly, I feel safe that no scientific statement or discovery can stop me in my progress across the Pacific, as long as water maintains its specific gravity of 1., and my nuclear engine so fortunately located within 93 million miles continues to cause the free winds to blow.

LETTERS TO SCIENCE DIGEST

Strong criticism

I have strong criticism regarding your article, "Row Over Rockets" (April '65). It stated that we will not get a man on the moon before 1970, on the grounds that there is nothing dramatic in the works at the National Aeronautics and Space Administration (NASA). It also stated that we have no schedule for interplanetary exploration after a moon landing is made by our astronauts.

You obviously do not know your space program schedule. All of the latest NASA journals and press releases by their administrative and scientific officials state that our schedule is progressing rather nicely. First is Project Gemini, which includes rendezvous in space with engines and extensive space maneuvers, men exiting from their spacecraft in space suits, and men living in space for up to two weeks. This will be completed in 1967. Surveyor robot laboratories will have landed on the moon and gathered extensive amounts of scientific data and Lunar Orbiter satellites will have mapped the moon. In 1967 we plan to begin extended three-man-spacecraft orbital missions. In 1968 we plan a manned moon orbit mission. That leaves the ability to land men on the moon in 1969 as planned. Certainly with the way our program is progressing, and with the way our schedule stands, we can definitely land men on the moon by 1969.

As for your opinion of our not having a schedule for interplanetary exploration after a moon landing, you yourself ran an article in an earlier issue stating a plan of NASA's for modifying and extending Project Apollo for interplanetary exploration.

JERRY FOGELMAN
Brooklyn, N.Y.

NASA is usually optimistic about making its schedules, but space programs have shown a tendency to "slip." Apollo is by far the most complex manned flight ever attempted by the U.S. and NASA is trying to do it on a tight schedule. If everything goes perfectly, of course, we can have a man on the moon by 1969. *But that's a big if. It is not unreasonably gloomy to speculate that the 1969 deadline may "slip" too.*

True, there was once a plan to use the Saturn V Apollo rocket for interplanetary manned flights, but as we pointed out in our April article, NASA no longer considers this a good idea. There will, of course, be unmanned interplanetary flights, but a budget aiming at manned interplanetary flights does not exist at present—Ed.

Oxygen in the air

After reading your article, "Stop Breathing and Live" (April '65), I wondered if any research has been done on the amount of oxygen in the atmosphere. What with our exploding population and the levelling of forests in various parts of the world, it seems possible that any balance

that once existed might now be hopelessly upset. Or do we have such a vast ocean of air that we need not worry?

A. J. GRAHAM
Vancouver, B.C.

Although forests are cut down, oxygen-supplying farms often replace them. The human population is exploding, but the total animal population remains fairly steady. There is plenty of oxygen in the air for our needs, in fact there are indications that the oxygen content of the atmosphere may be rising. The problem is not lack of oxygen, but whether the air will be clean enough to breathe.—Ed.

Inside the sun

In your article, "How to Study the Onion" (April '65), it was stated: "The sun's thermonuclear core is probably about 14,000° C."

My physical science professor and I had a bit of an argument about this. He said the core temperature is about 35,000,000° C. Quite a difference!

Needless to say, I am an avid *Science Digest* fan for it helps greatly with my science studies, besides keeping me entertained and informed of the latest scientific discoveries.

C. D. LOCKRIDGE
Ferris State College
Big Rapids, Mich.

Your teacher was a lot closer to being correct than we were. The present estimate of the sun's thermonuclear core, based on information released by The American Institute of Physics, is 14,000,000° *C. We dropped the last three zeros in a typographical error.—Ed.*

Happy accident

I accidentally picked up an issue of your magazine at a newsstand a few days ago. I did not know that it was in existence prior to this. Your lengthy article on the Aswan Dam ("How Abu Simbel Is Being Saved," April '65), particularly interested me inasmuch as our fifth grade Social Studies class studied about it last year. It is certainly a very informative article.

Mrs. T. H. Brown
Steubenville, Ohio

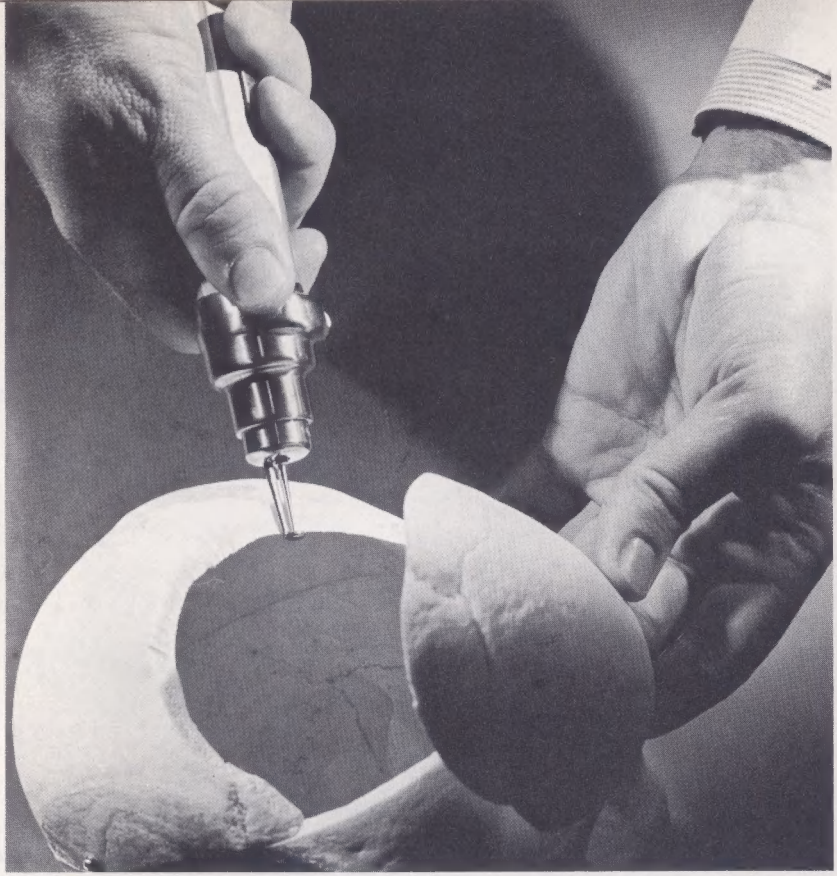
Fact, not opinion

I am a grade 12 student this year and I have enjoyed your magazine for the last five years. I think it is very commendable. However, I think dropping of your semi-annual index was a mistake. The index was very handy and I often referred to it.

I hope to see more articles on space and chemical and physical developments and less on the social aspects of life. I would also like to see articles based on fact and not on opinion.

DONALD BENGTSON
Brooks, Alberta
Canada

We remind readers wanting to look up articles in past issues that Science Digest *is indexed in* Reader's Guide to Periodical Literature.—*Ed.*



Instant hole in the head

REMOVING the top of the skull prior to a brain operation always has been a difficult task for the neurosurgeon.

In the past, this surgical procedure has been performed with hand tools and wire saws, a technique which has not changed essentially for hundreds of years.

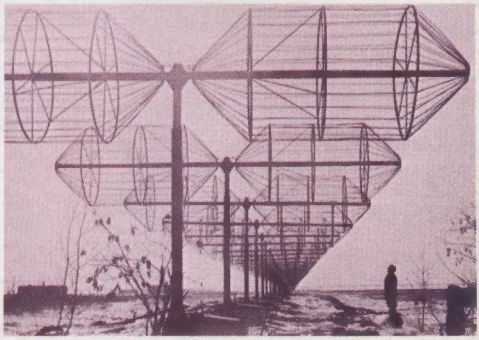
Now a new air-powered surgical instrument has made the old technique obsolete. The instrument, called a Neurairtome, was introduced and demonstrated recently. It was developed by Dr. Robert M. Hall, a Pittsburgh, Pa. oral surgeon. The instrument performs more safely in two minutes a surgical procedure that normally used to take a neurosurgeon an hour to execute under adverse, tiring conditions.

The finger-tip-controlled, air-driven instrument weighs less than a pound, develops 1/6 horsepower, and rotates at speeds up to 24,000 revolutions per minute. It cuts through bones by means of a rapidly spinning router blade.

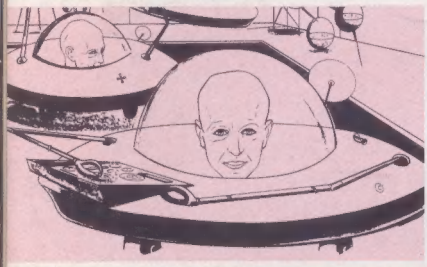
In this issue . . .

Bloodhounds have about the best noses in the animal kingdom; men, about the worst. A challenging quiz about our subtle and most neglected sense, the sense of smell, begins on page 89.

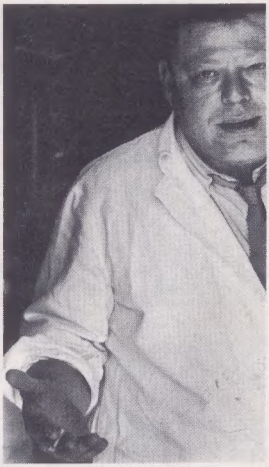
In Dr. Laurence E. Morehouse's Human Performance Laboratory at UCLA, volunteers are tested to see what makes the human machine tick and how to make it tick better. See story on page 60.



With this giant Russian radio-telescope, Soviet astronomers thought they heard signals from another world. Did they really hear them? The story begins on page 66.



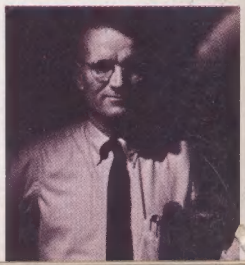
Are these barely human "saucer men" a vision of the future of mankind? Professional planner Dandridge Cole thinks they might be. The story of Cole and his amazing and accurate predictions for a U. S. company begins on page 9.



Mars life? "Yes." So says biologist Sanford Siegal after he placed earth creatures in a Mars-like environment and saw them thrive for long periods of time. For an up-to-date story on Mars, turn to page 44.

What makes the mighty winds blow? For a simple explanation, see story on page 86.

Physicist Val Fitch spent months on a highly complex, fantastically expensive experiment, trying to find something that did not exist. Because it didn't, our whole picture of the universe may fall. See page 28.



Far out in the universe, where only the giant telescope's eye can see, is a spiral galaxy with a mysterious ring. See story on page 26.